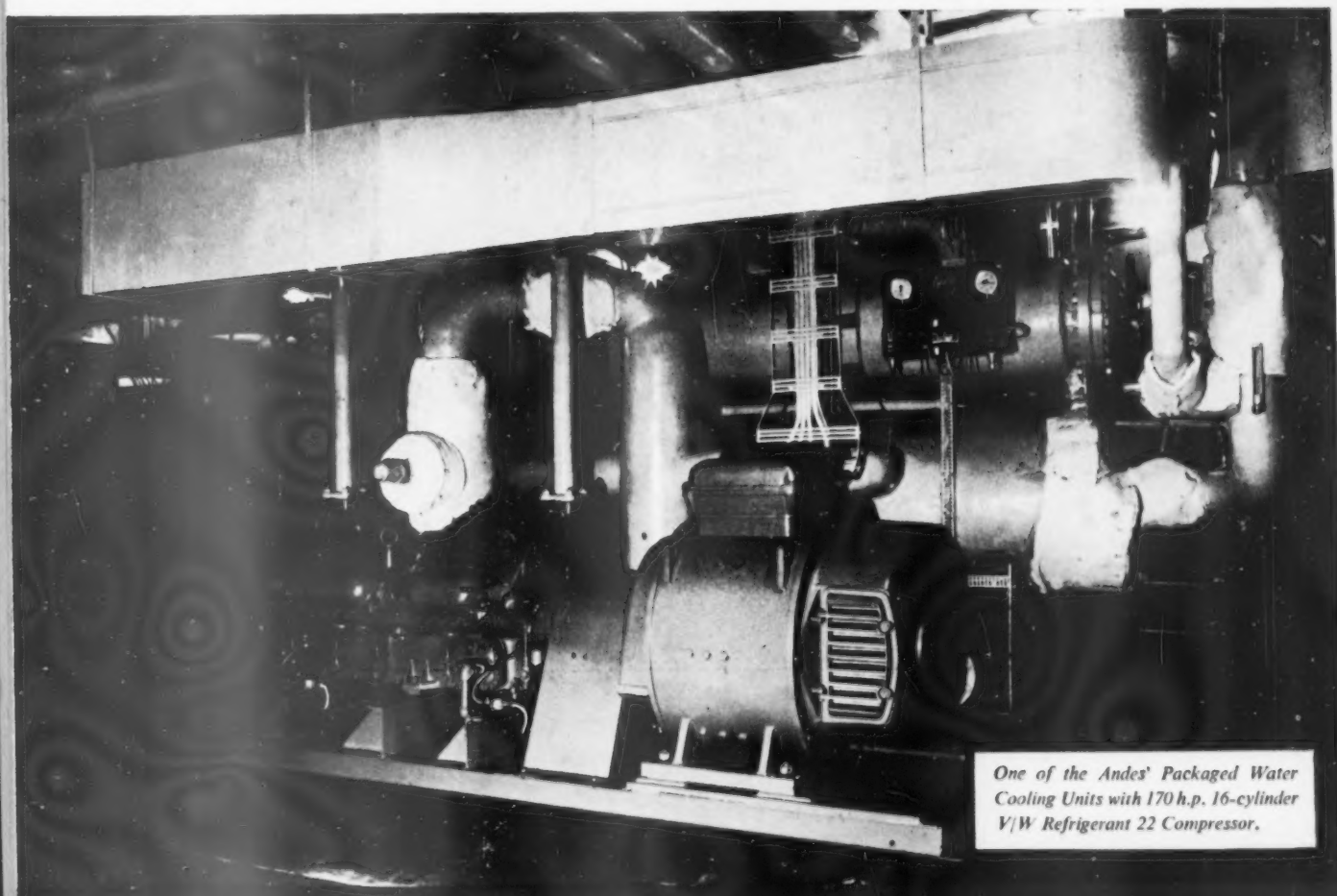
Vol. 63 No. 751 OCTOBER, 1960 Price 2s. 6d. monthly



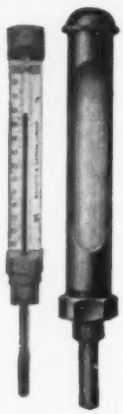
One of the Andes' Packaged Water Cooling Units with 170 h.p. 16-cylinder V/W Refrigerant 22 Compressor.

Keeping track of temperature

—is a matter of degree. Temperature indicators recorders or controllers, Negretti & Zambra make them all do the job for you—exactly. You can be sure, too, that their fine accuracy will be matched by an inherent robustness: long life is built in.

Porcelain Thermometer for Cold Stores

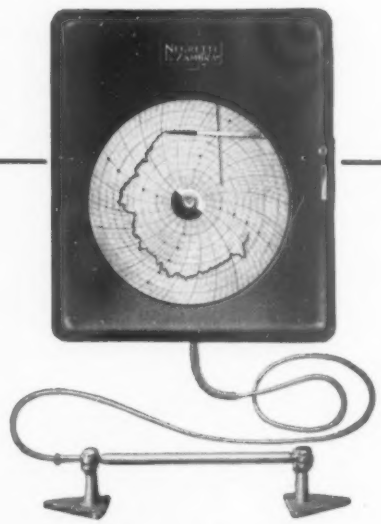
Metal Scale Thermometer for Refrigerated Chambers



Brine Pipe Thermometers

Dial Thermometer. Standard Type for Cold Stores

Multi-point Resistance Thermometer



"Mersteel" Temperature Recorders. Standard Type for Cold Stores

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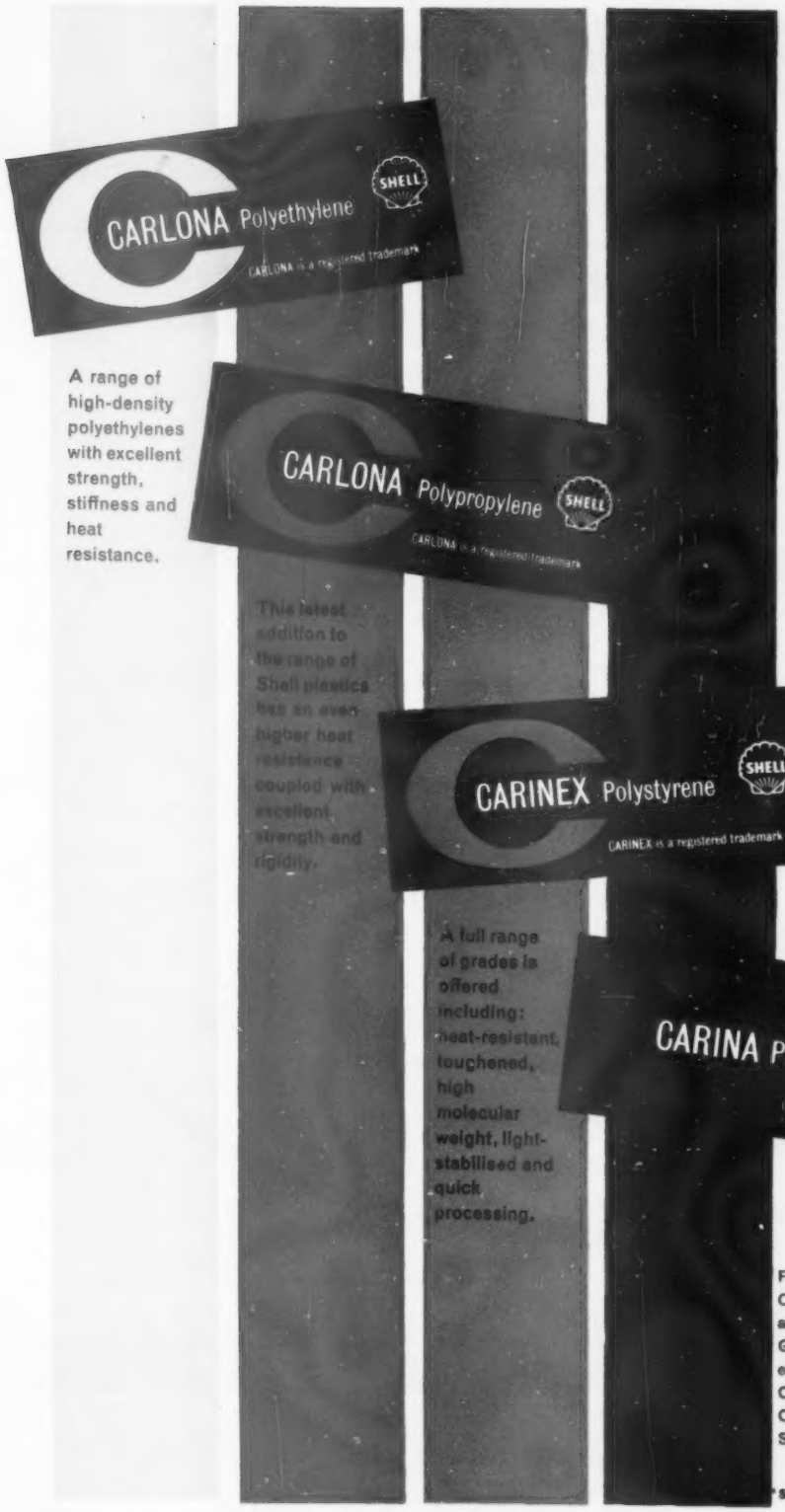

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A range of high-density polyethylenes with excellent strength, stiffness and heat resistance.

This latest addition to the range of Shell plastics has an even higher heat resistance coupled with excellent strength and rigidity.

A full range of grades is offered including: heat-resistant, toughened, high molecular weight, light-stabilised and quick processing.

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3 aids to efficient operation of coldrooms...by the coldroom problem specialists!

Miniveil

AIR CURTAINS FOR OPEN COLDROOM DOORS

- COMPLETELY UNIMPEDED DOORWAYS!
- MAINTAINING TEMPERATURES!
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PART HEIGHT FLEXIBLE CLOSURES FOR CHILLROOM DOORWAYS

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Dual-Temp refrigerator freezer

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DIMENSIONS:

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(approx. only)

Price **£179 10. 0.**
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SPECIAL FEATURES OF THE LEC 12-6
Model 518

Tall Bottle Area
Sliding Shelves
Butter & Cheese Compartments
Adjustable Aluminium Door Racks
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Other models from the great LEC range

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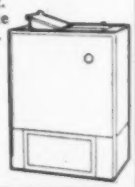
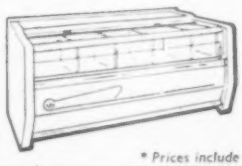
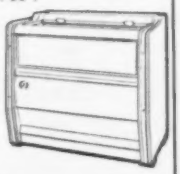


GS 91
Super Salesman. Capacity: 11.4 cu. ft. Height: 42¾". Length: 72". Width: 30". Price: £230.10.0.*



GSD 71
Junior Salesman. Capacity: 7.1 cu. ft. Height: 42¾". Length: 46". Width: 30". Price: £149.10.0.*



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Please send me full details of the Lec 12-6 and other commercial cabinets.

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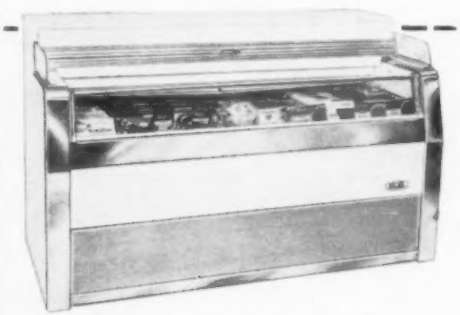
The HELIFROST freezers come to Britain...

HELIFROST is the name of the new, advanced range of deep freezers and frozen food merchandisers introduced to Britain by Elektrohelios of Sweden. Leading Swedish organisation in the domestic electrical appliance field, Elektrohelios is also the largest firm in Europe producing deep-freeze equipment.

In Sweden, Elektrohelios is a household word. The name stands for 40 years' experience of electrical appliance manufacture. One of the company's five factories, that in Mariestad, is the only one in Europe designed exclusively for large-scale quality deep freezer production. There, mass-production is carried out under conditions of continuous quality control. That is one important factor. A second is the use of thoroughly up-to-date technical equipment. Number Three is the close co-operation between Swedish and British experts in their special fields. British manufactured vital parts include the copper tubing—thermostat—the high-capacity Tecumseh compressor by the renowned Sterne of Glasgow organisation. Swedish-British collaboration achieves *utmost dependability*. 'Helifrost' spells good news for the trade.

ELEKTRO HELIOS

The Helifrost freezers will be marketed in Great Britain by the Sole Agent in this country, Helimatic Ltd., who will provide nationwide service facilities in close co-operation with the trade.



Chest freezers from 5.3 cu. ft. to 19.6 cu. ft.; upright freezers from 9 cu. ft. to 20.5 cu. ft.; merchandisers from 11 cu. ft. and automatic defrosting models from 17.5 cu. ft. All Helifrost models are fully guaranteed and covered by warranty arrangements.

Helimatic Ltd.

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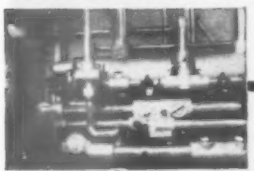
SMITHS

have many strings to their bow...



Our great achievements in designing and building many of the largest and most up-to-date cold stores in the country have taken us right to the forefront of the industry. But the design and construction of large cold stores is not our only activity. We are also specialists in all the "built-in" applications of insulation, factory insulation, and pipe insulation and boiler covering; have been for years! No job has ever proved too big or too difficult for Smiths, so if you have a project in mind of any sort involving insulation or cold storage, why not consult our design engineers first? There will be no cost or obligation, and remember, we can handle the job completely, right from the original drawings.

Cold Store design and construction

"Built-in" applications of insulation

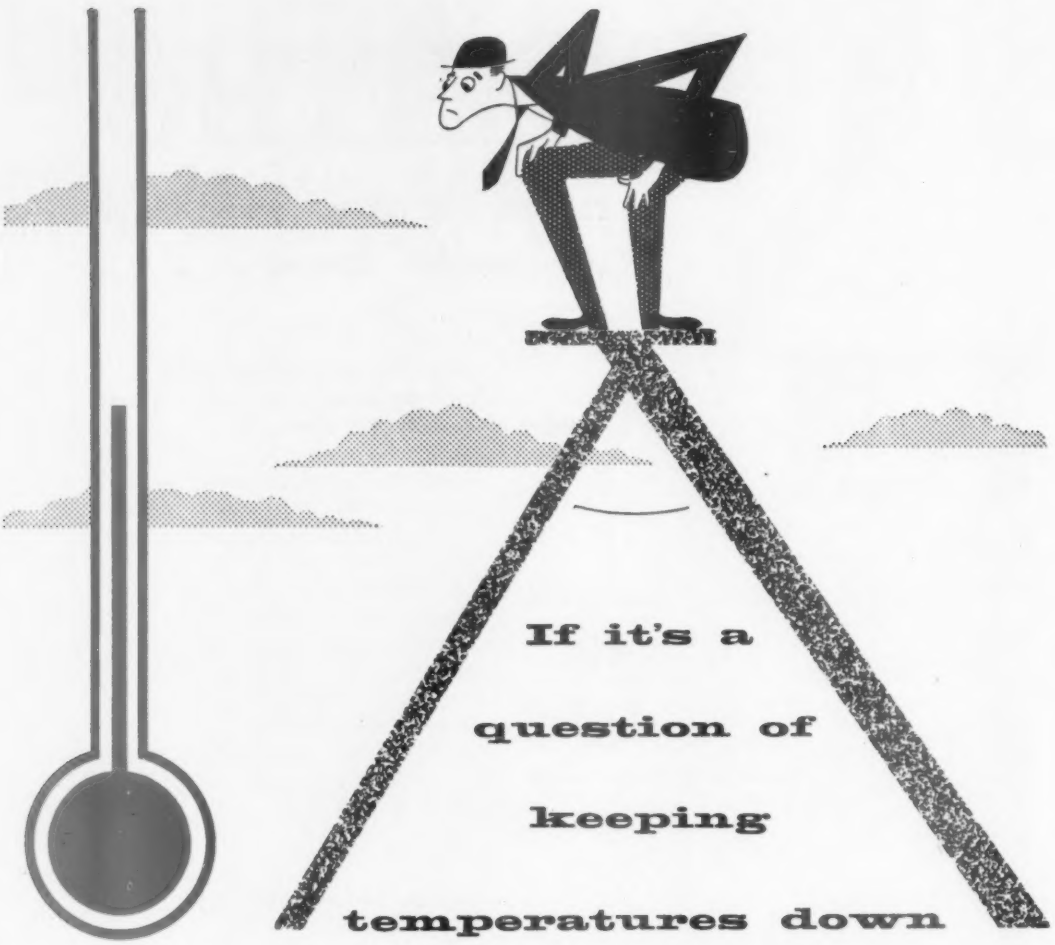
Factory Insulation

Pipe Insulation and Boiler Covering

Smiths Insulations Ltd.

Est. 1874 **Burton-on-Trent** Tel: 2061/2

London Office: 105 Empire House, St. Martins-le-Grand, E.C.1. Tel: MONarch 2000



Whenever low temperature insulation is concerned, Newalls are the people to look to. They have a background of over 50 years experience in all kinds of contracts—in cold stores, in cargo and passenger ships, in breweries and creameries — in fact wherever there are refrigerated spaces.
Newalls supply *and* apply low-temperature insulation materials and their service is available through each of eight depots situated throughout the United Kingdom. When the specification calls for a first class job, call in Newalls.

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YORKSHIRE IMPERIAL METALS LIMITED

YORKSHIRE IMPERIAL

LIGHT GAUGE COPPER AND COPPER-ALLOY TUBES and "YORKSHIRE" CAPILLARY FITTINGS

for refrigeration and air-conditioning plant

" Yorkshire " Capillary Fittings, incorporating tin-silver solder rings, are especially suitable for joining copper and copper-alloy tubes operating at low temperatures in refrigeration and other services.

They incorporate, as an integral part of the fitting, the correct amount of solder for making quick, sound and trouble-free joints which are proof against seepage by refrigeration gases and other fluids under pressure.

The appearance of a complete ring of solder at the mouth of the fitting is visual proof of a sound and reliable joint.

Pipework arrangement—incorporating " Yorkshire " Fittings—in compressor room at the Birtley Factory of Messrs. Kraft Foods Ltd. (installation by Messrs. L. Sterne & Co. Ltd.)

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More B.T.U.'s PER WATT!

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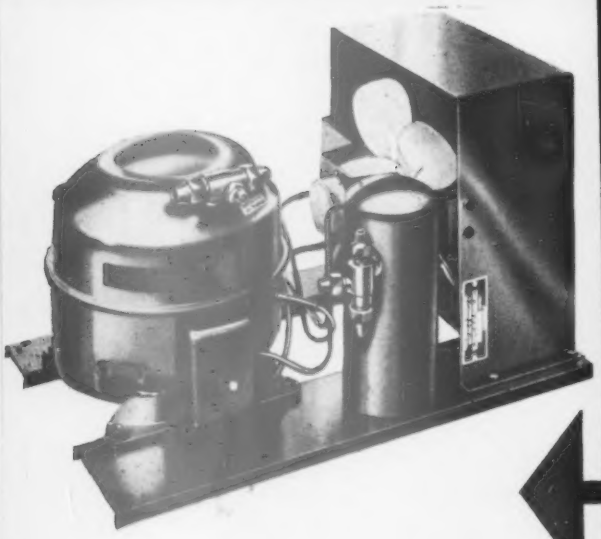
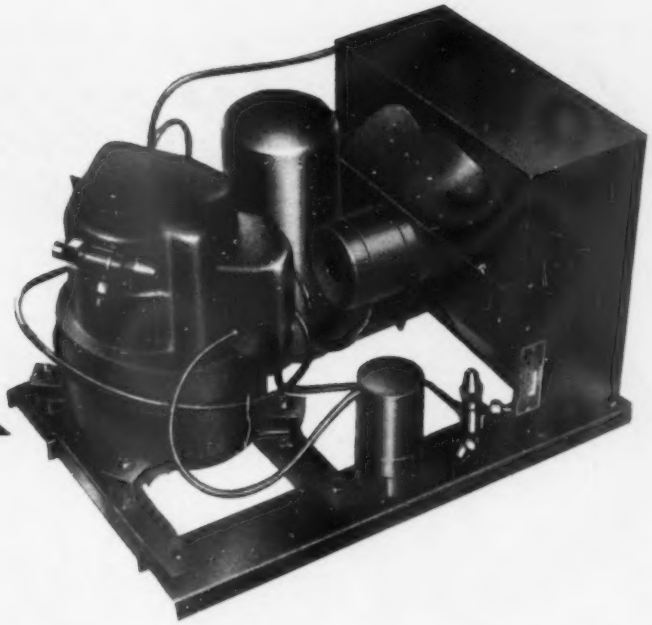


and the latest addition to this extensive r



Our range of condensing units comprising ¼, ⅓, ½, ¾, 1 and 1½ horsepower are based on designs of the famous Tecumseh Products Company, U.S.A., and are manufactured by us under exclusive licence. More compact and more economical, in a variety of models, they offer a complete and comprehensive range for the manufacturer of cold rooms, display cabinets, conservators and air conditioners. The ¼, ⅓ and ½ h.p. are single cylinder units; the ¾, 1 and 1½ h.p. are twin cylinder condensing units. Please write for further information.

- **Super silent—very suitable for air conditioners.**
- **Standardised by leading manufacturers throughout the world.**
- **Large selection of high and low torque units available.**

nge of condensing units — THE 1½ H.P. UNIT

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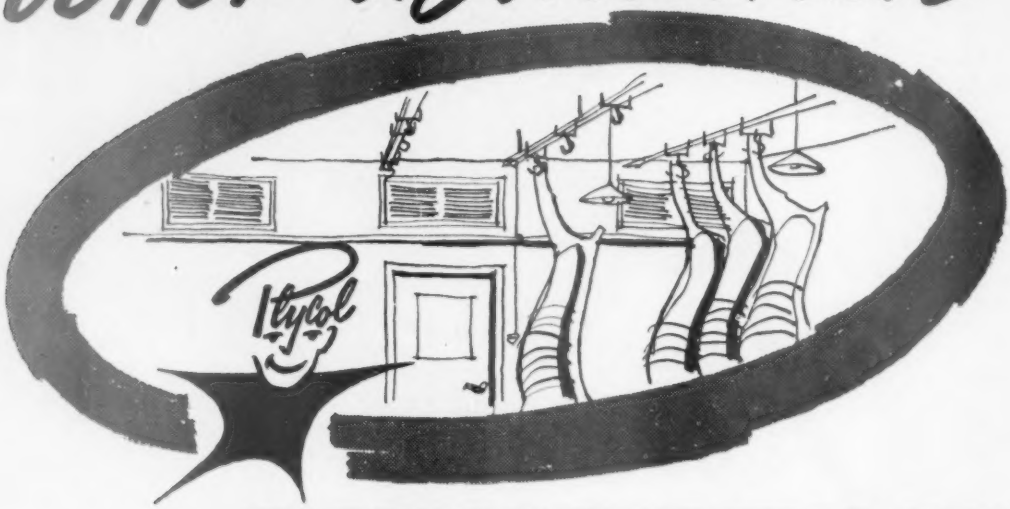
better insulation



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The **BITUTHERM** range of products for the insulation contractor **ENSURES**
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Write NOW for full particulars, or consult our Technical Insulation Department at Slough on problems of protection, adhesion and finishing.

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temperature
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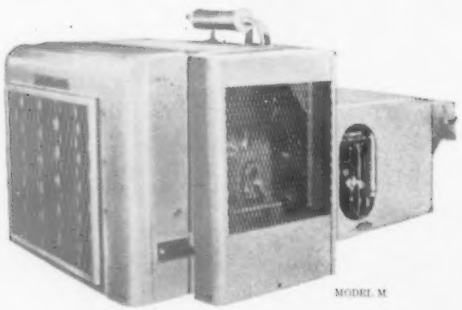
AND PRICES DOWN!

Showing production line of Thermo King refrigeration units Models KL and M. These can be installed in straight trucks or trailers and will maintain automatically the temperature required for frozen foods, dairy products, meat, fish, etc.



MODEL M

Increased demand and production in Great Britain of the world-renowned Thermo King refrigeration units have already made possible substantial price reductions. Thermo King units are built with 50% British components, and this percentage will be increased in the near future.

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UNION CARBIDE MOLECULAR SIEVES

UNION CARBIDE Molecular Sieves dry refrigerants more efficiently than any other desiccants. PLUS these advantages:—

SUPERIOR CAPACITY AT LOW WATER CONCENTRATIONS
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UNION CARBIDE Molecular Sieves re-establish the whole economy of drying refrigerants on a new basis and offer profitable opportunities for development. Detailed information is available on modern desiccation techniques, using Molecular Sieves.

IT PAYS TO USE—

BECAUSE THEY ARE:

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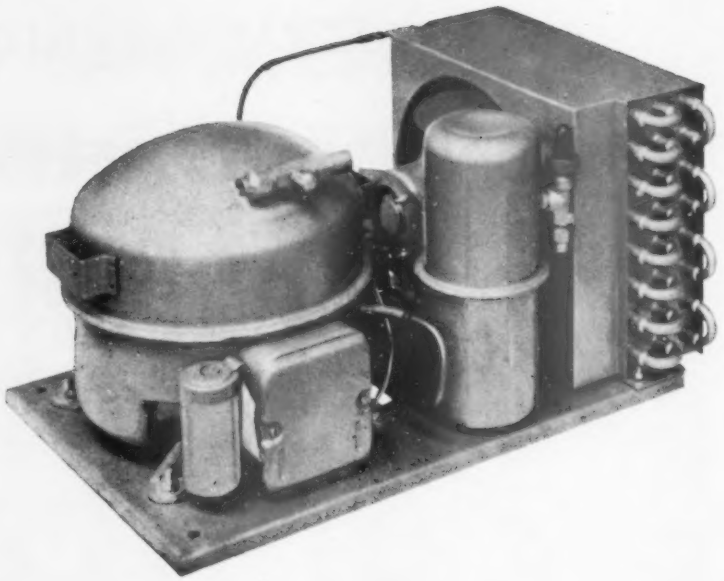

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Household and commercial compressors and condensing units 1/14 to 1 HP.
Household and commercial systems

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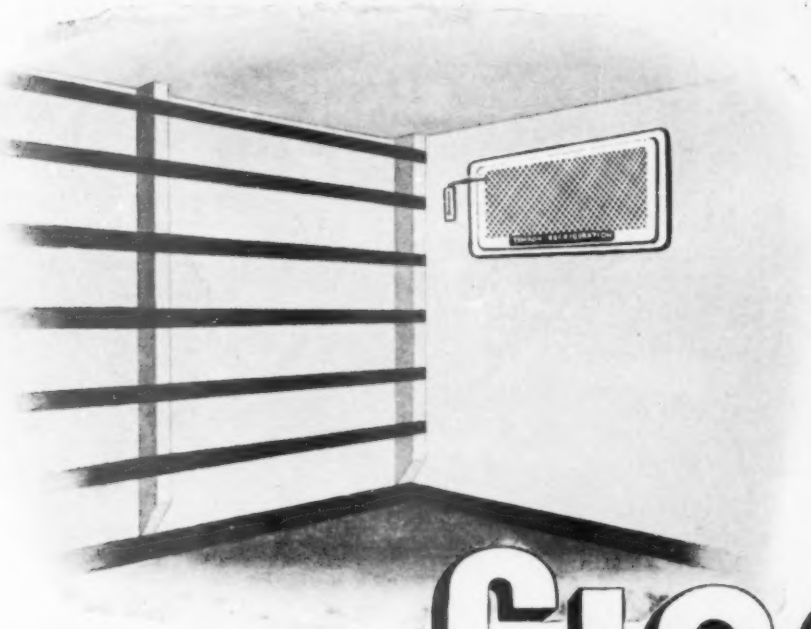

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Only* TEMKON *Packaged Units make this possible!

They are completely self-contained – are delivered factory wired and piped for easy, low-cost installation – supplied with installation kit.

- ★ Low temperature range – 5°F to +38°F.
- ★ Medium temperature range 36°F to 60°F.
- ★ 1½ Horse power.
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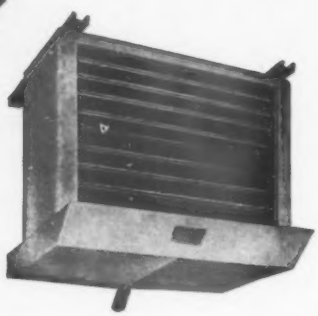

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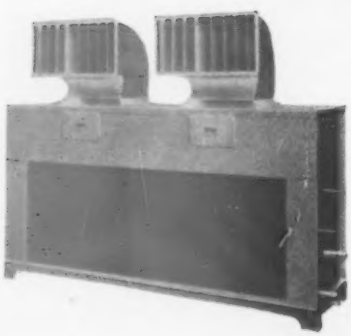
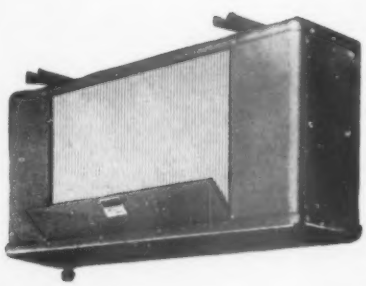
SUITABLE FOR AN INFINITE VARIETY OF APPLICATIONS

Each Fully Guaranteed

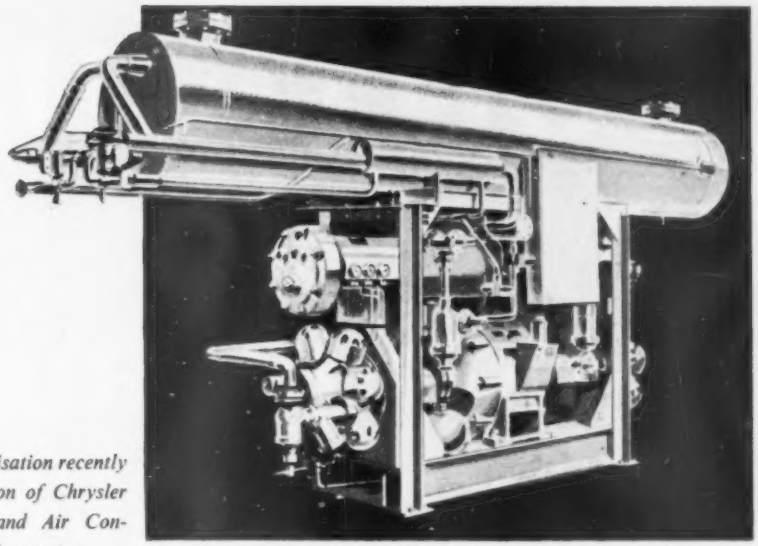




CHRYSLER CHOOSE ONE FROM 300

TO introduce THE

CHRYSLER AIRTEMP RANGE



The Chrysler Organisation recently announced the introduction of Chrysler Airtemp Refrigeration and Air Conditioning equipment to this country

There are *300* models in the Airtemp range, covering virtually every commercial and industrial Refrigeration and Air Conditioning application. On this page, we can show only one. We choose the 'W' Series Chiller because it illustrates so clearly what we mean by "Chrysler Airtemp — a new concept in equipment design."

THE 'W' SERIES PACKAGED LIQUID CHILLER

- *A compact, purpose-made packaged unit, single and dual system delivered in one piece ready for commissioning.*
- *Refrigerant Freon 22 or 12.*
- *Latest American designed condenser giving 25% increased cooling per ft. run.*
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- *Chrysler service backs every installation.*
- *Chrysler offers 25 years of experience.*

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A NEW CONCEPT OF COOLING AND CONDITIONING

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The recording spectrophotometer and integrator in routine use in our control laboratories permits exact numerical measurement, using internationally standardised lighting, and ensures colour continuity.

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Paint Specialists since 1840

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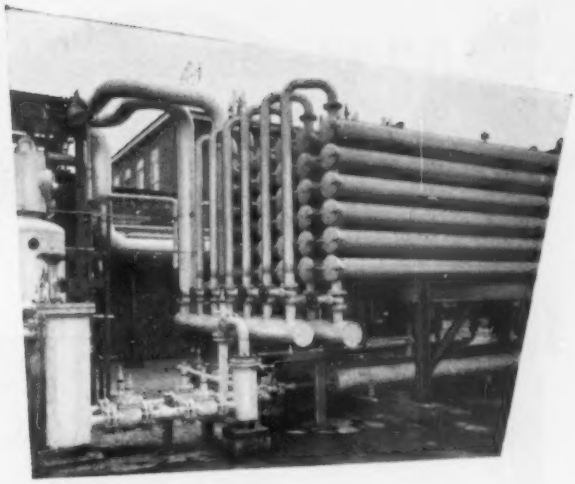

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ACRYLONITRILE

UDEC refrigeration equipment absorbing 1000 horsepower provides controlled cooling at various points in the new I.C.I. acrylonitrile monomer plant in the Cassel Works of I.C.I at Billingham.

The plant will provide the plastics and synthetic fibres industries with the vital acrylonitrile monomer.

Whatever your problem in industrial refrigeration, UDEC can provide the answer —efficiently, economically.

The line of specially designed air cooled freon boosters at Billingham.

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AIR COOLED DIESEL

Lister air-cooled diesel engines provide smooth-running **reliable** power for all types of refrigeration plant, and because of their light weight and compact design are ideally suitable for mobile units. They can be provided with either electric starting or fully automatic control equipment.

The service of Lister specialist engineers is freely available for advice and consultation on request.

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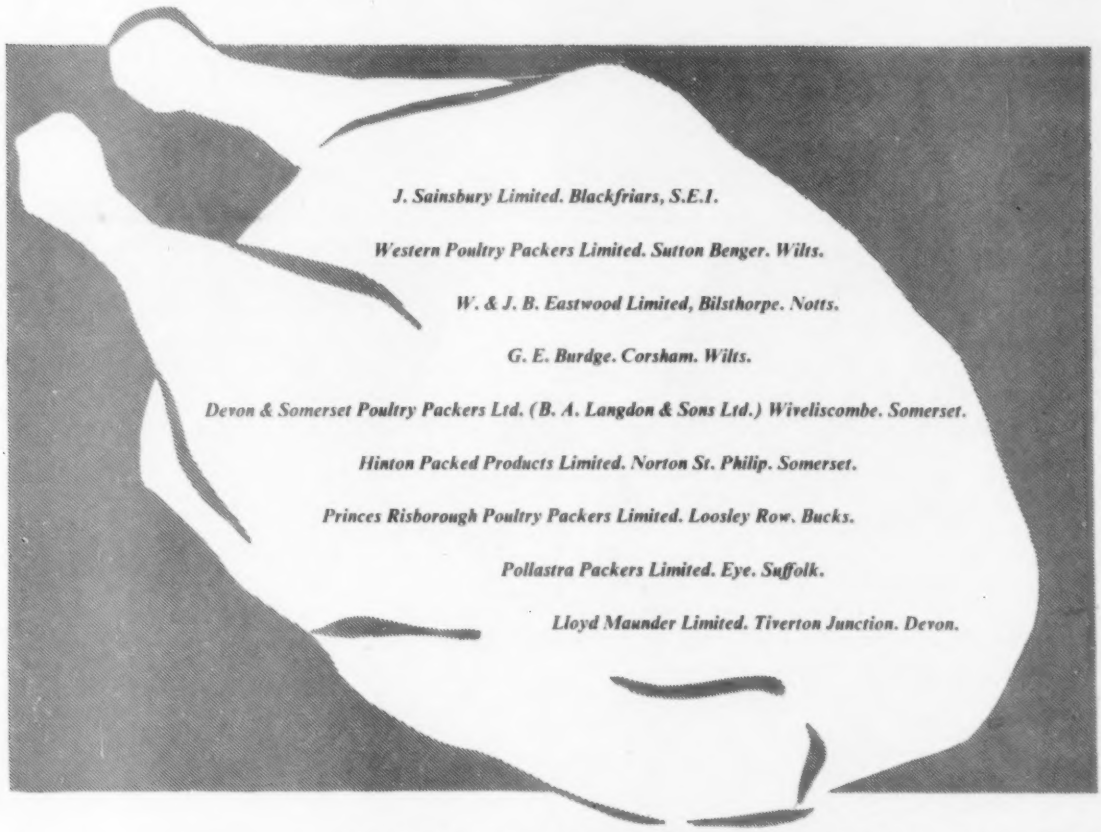
THESE LEADING BROILER PROCESSORS


J. Sainsbury Limited. Blackfriars, S.E.1.
Western Poultry Packers Limited. Sutton Benger. Wilts.
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G. E. Burdge. Corsham. Wilts.
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The DOUGLAS system for QUICK FREEZING poultry
produces a bird of the best possible quality and colour.
It has been specially designed for its purpose and is arranged to fit readily into the production line.
It is adaptable to any layout and can be arranged to take care of expanding output as production grows.
If you want to know more about the Douglas quick freeze system, (and Douglas dry rendering plant which converts waste, including feathers, to poultry feeding stuffs), write to:

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Effective insulation is a question of balance

STYROCELL is a rigid, lightweight material consisting of a profusion of non-communicating air cells encased in polystyrene. By maintaining a fine balance between its weight and the volume of trapped air, STYROCELL provides a barrier of virtually still air—the ideal thermal insulant. In addition to its light weight—1 lb. per cubic foot—STYROCELL is inert, rot-proof and possesses a low water-vapour permeability, good mechanical strength, chemical resistance and electrical properties. Easy to handle and to work, STYROCELL is an inexpensive material that gives new meaning to effective thermal insulation. Available in either standard or self-extinguishing grades—in thicknesses from ½" - 10".

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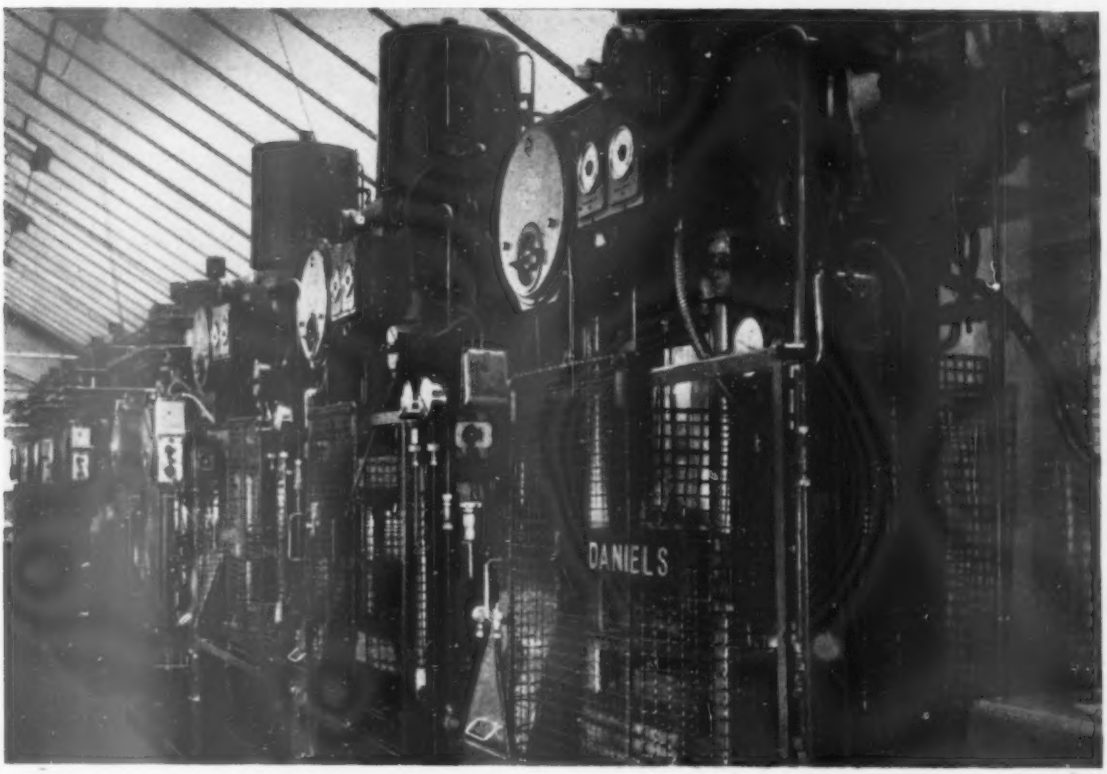

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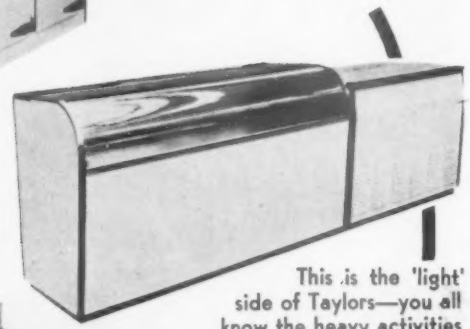
'A FEW OFF' is our business but we make in quantity.

However diverse, we are equipped to produce.



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A fine finish and sound design, are 'built in'.

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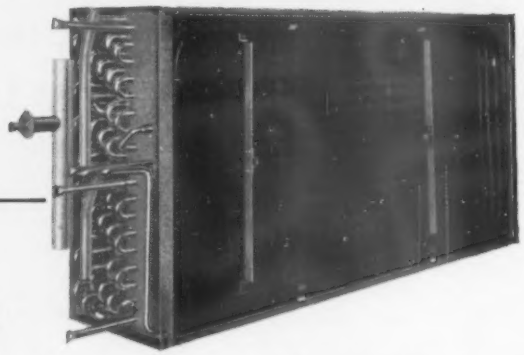
SPIRAL TUBE Coolers

REFRIGERATION EQUIPMENT



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Dehydrated and sealed for use with refrigerating plant.

COILS

Water cooled, cooling coil for Transformers

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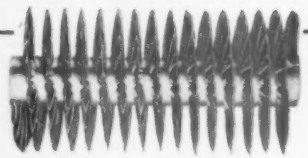
We should be pleased to advise on the choice of Finned Tube to meet any specific requirement



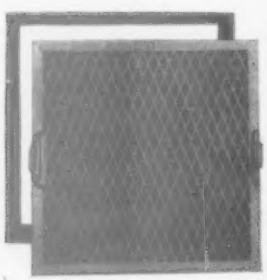
Designers and Manufacturers of engine, oil, and water coolers, Air Heaters, Transformers, also Unit Air Heaters

SPIRAL TUBE & COMPONENTS CO. LTD., OSMASTON PARK ROAD, DERBY Tel.: DERBY 48761 (3 lines)

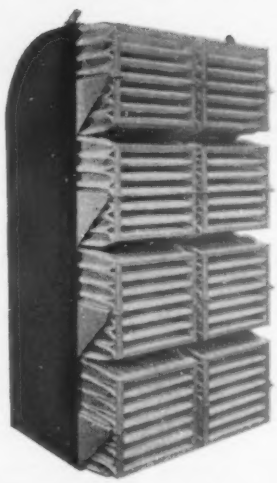
Head Office : Abbey House, 16, High Street, Watford. Telephone : Watford 26781/2

Scottish Office : Messrs. McCulloch & Miller, 180, West Regent Street, Glasgow, C.2 Telephone : City 4704/5

WET or DRY...



VISCO "KM" Type Oil-Wetted Air Filter



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VISCO Air Filters devour dust. Air filtration economics can be solved the VISCO way. Both types are simple, robust, reliable, efficient. The oil-wetted filters operate in such a way that collected dust in turn helps to collect further. Each cell has tremendous capacity and is easily cleaned. VISCO "MV" dry-type filters are over 98% efficient. Each unit will deal with up to 1,000 c.f.m. Throw-away filter elements are easily changed after several hundred hours active life. Full information from THE VISCO ENGINEERING CO. LTD., STAFFORD ROAD, CROYDON. Telephone: CROydon 4181.

VISCO

Air Filters

FWS

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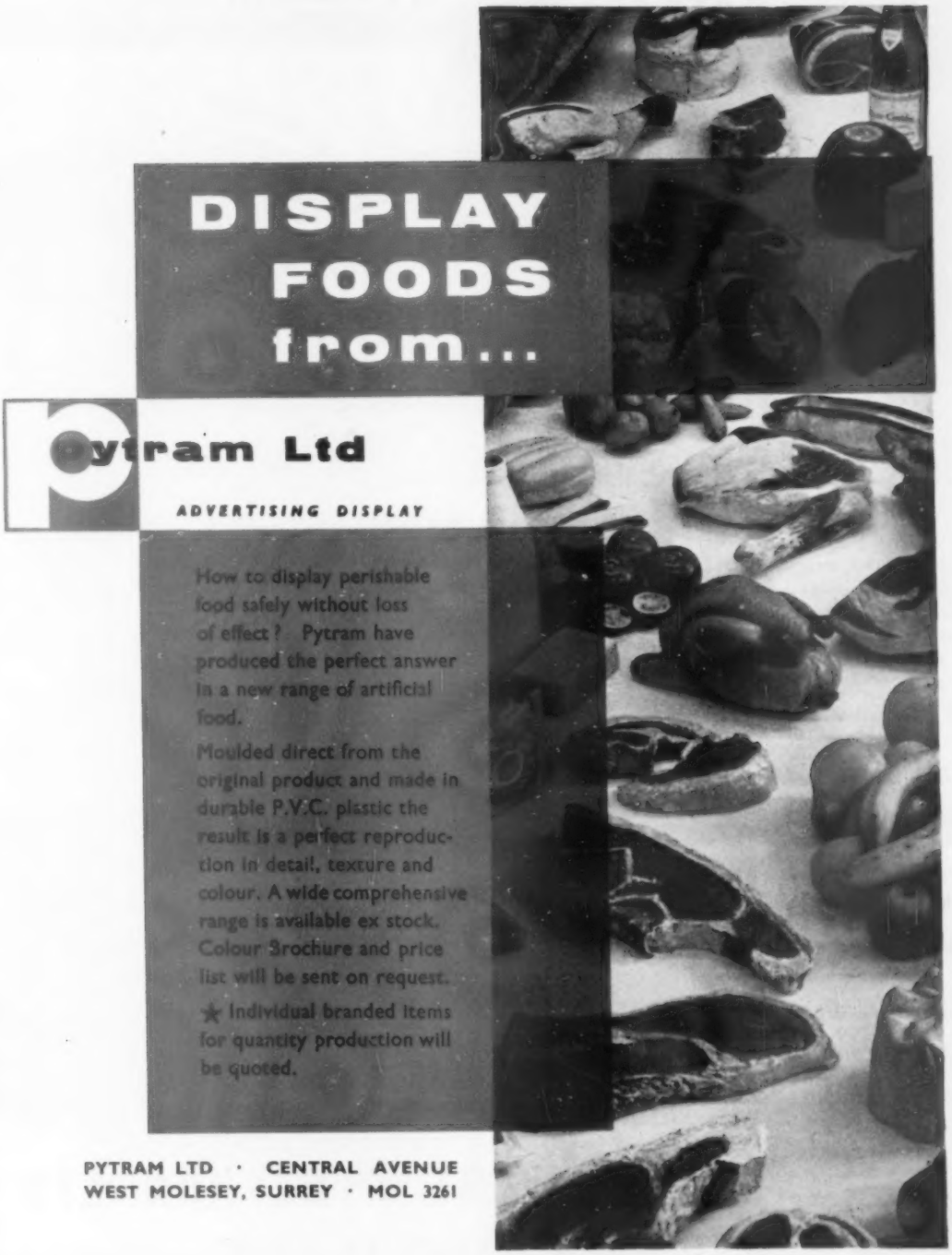

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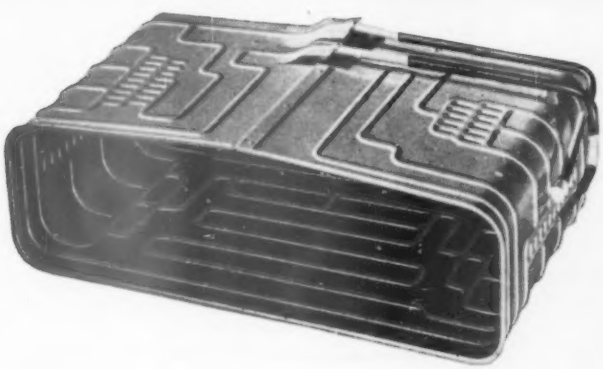

Marston Excelsior Ltd.,
a subsidiary of Imperial Chemical Industries Ltd.
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Telephone: Leeds 63-7351

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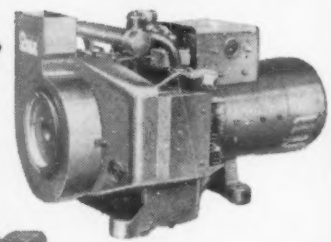
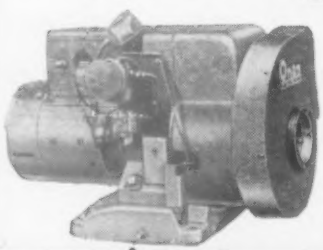
5 KW. Weight 375 lbs. Length 33". Width 21". Height 21". Moves 570 CFM of air. 2-cylinder petrol engine. Utterly reliable and trouble free. Long-life bearings.





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2½ K.W. Weight 126 lbs. Length 23". Width 15½". Height 19". Moves 180 cubic feet of air per minute. Single cylinder petrol engine. Utterly reliable and trouble free.

Confined vehicle space cannot cramp the performance of ONAN air-cooled electric plants fitted with unique ONAN VACU-FLO suction cooling system. No need for auxiliary ventilating fans. A specially designed direct-drive centrifugal blower draws in cool air to the generator and over the engine, exhausting heated air through outlet duct.

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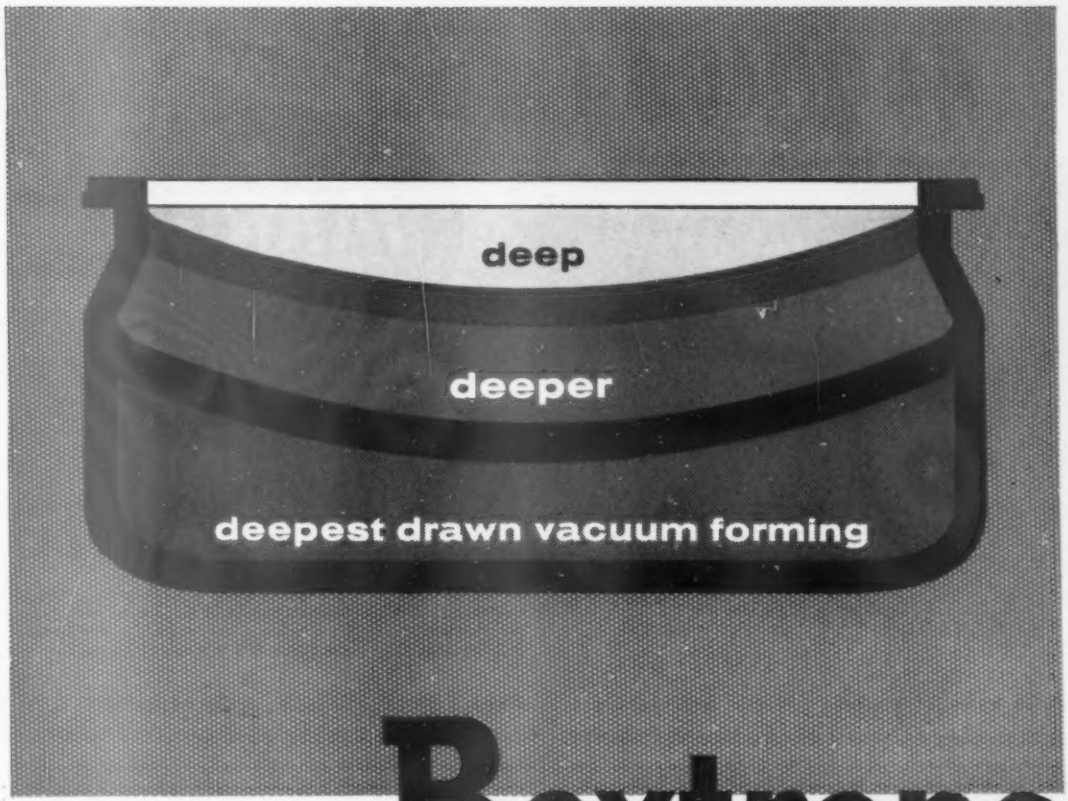

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SHEET for Frigidaire

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- Robust fully insulated night cover.

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There is so much more to a Secura cabinet

MORE flair in design makes this unit an eye catcher in any shop.

MORE attention to detail is evident in the gleaming stove-enamelled finish, the plastic dipped shelves, the obvious quality of each component.

MORE robust construction combined with faultless insulation ensures peak performance from your unit.

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HERION COMPONENTS OF QUALITY

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HANDWHEEL VALVES
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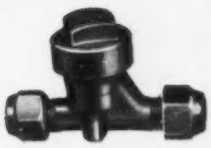
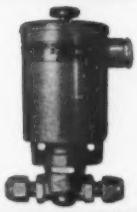
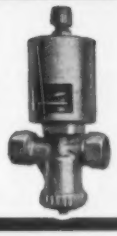
5 

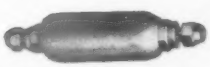
CHECK VALVES
¼" to ⅞"

SOLENOID VALVES
⅛" to 2" seat size

2 

WATER VALVES
Pressure operated or Thermostatic
⅜" to 2" pipe

6 

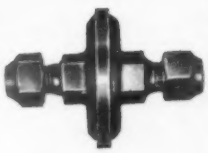
3 

'MOBILBEAD' DRIERS
¼" to ⅝" Flare—
2½ to 61 cu. ins.

7

AIR THERMOSTATS
Mercury Switch
Silver Contacts

LIQUID FILTERS

4 

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to Specification

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'Y' STRAINERS
for Water or Refrigerant, easily removable screens

Fit the HERION MOISTURE INDICATOR and **SEE** *your installations are* **DRY**

Also for AMMONIA
Water Valves
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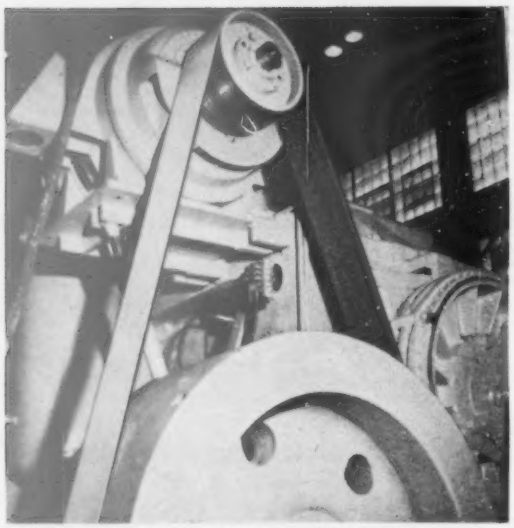

TURNERS POLY-V (TRADE MARK) DRIVES

THESE *Well proven* DRIVES

ELIMINATE THE 'V' BELT

MATCHING PROBLEM

SAVING SPACE, TIME, MONEY AND THEY

TRANSMIT MORE POWER

TURNERS 'POLY V' BELTS DRIVING: (top) 25000 TON FORGING PRESS (left) GRANITE CUTTING SAW (middle) CRUSHER GENERATOR (right) COMPRESSOR

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AND SEE WHAT WE MEAN

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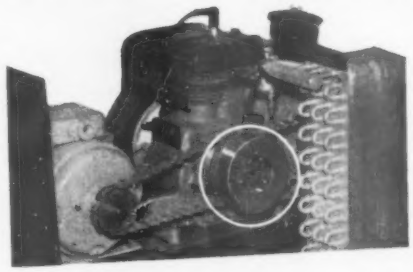
AUTOMATIC *controlled* TRANSMISSION

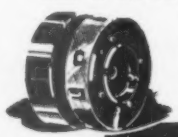
for mobile

REFRIGERATION UNITS



with **BROADBENT** *centrifugal* **CLUTCHES**

● This ingenious application ensures automatic operation from the driver's cab ; the diesel engine drive is put into operation by starter button, under no-load conditions.
In the garage when the refrigeration unit is driven by the electric motor, the diesel engine is automatically cut out by the **BROADBENT Centrifugal Clutch**



BROADBENT

THOMAS BROADBENT & SONS LIMITED

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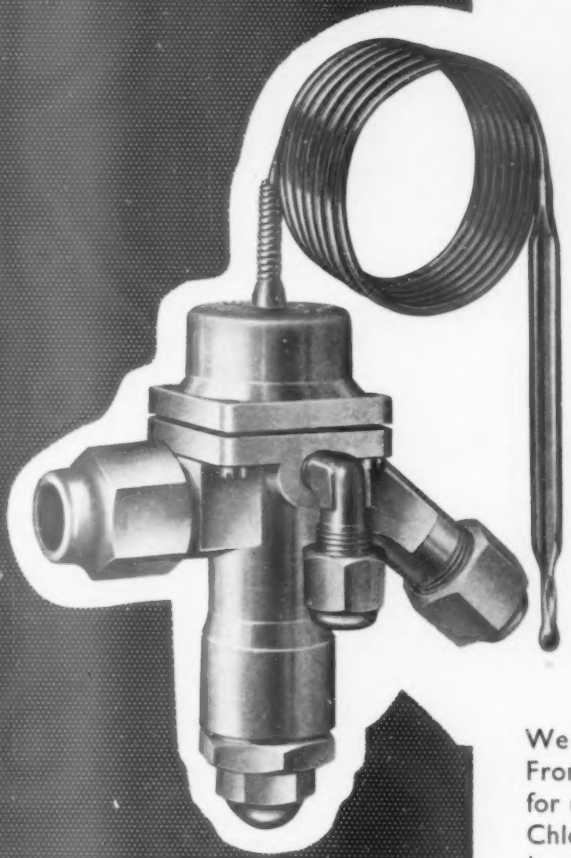

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SMALL CAPACITY EXTERNAL EQUALISED THERMOSTATIC EXPANSION VALVES TYPE TVE 1-4mm

We can supply a DANFOSS T.V. From .040" orifice size upwards—for use with R.12, R.22, and Methyl Chloride Refrigerants. A Distributor can be supplied for **any** size of Danfoss external equalized valve. These valves are designed for use for:—

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TYPE TVEFM ·040"/0·120"
for R.12 - Temp Range - 40°/+41°F
„ CH3CL „ „ - 22°/+41°F

TVE/F ·040"/0·120"
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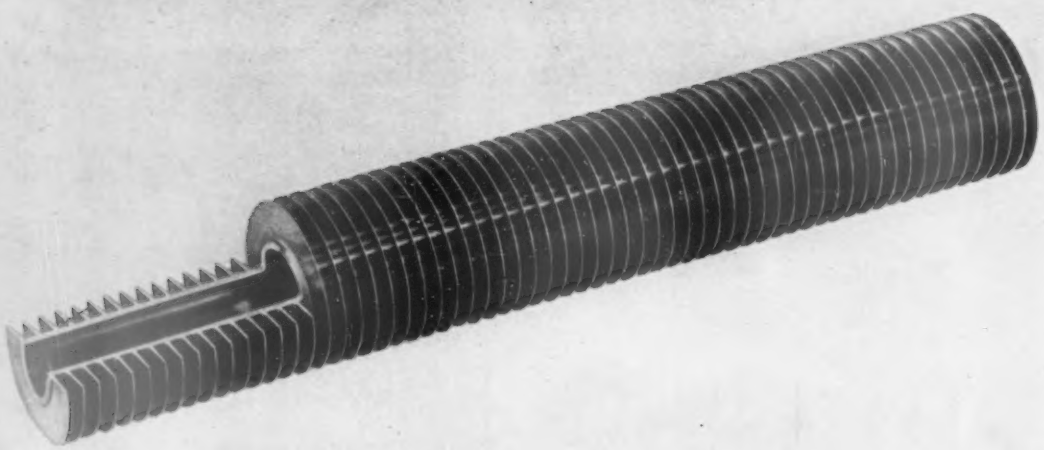

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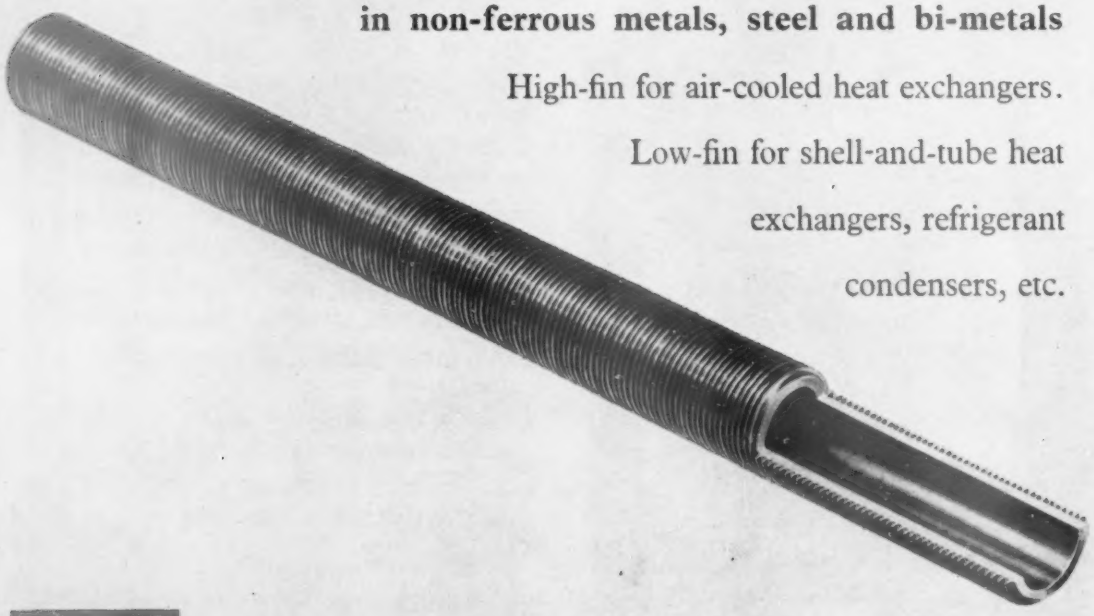
Integral finned extended surface tubing

in non-ferrous metals, steel and bi-metals

High-fin for air-cooled heat exchangers.

Low-fin for shell-and-tube heat exchangers, refrigerant condensers, etc.



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IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1.

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'Shanklin'

FROZEN FOOD DISPLAY CABINET

The new Shanklin Frozen Food Cabinet is self-contained so that there are no installation problems. Just plug into the mains supply and it's ready for business. The open top encourages customer impulse buying which means increased profits. The storage is carried to the full depth of the cabinet, permitting a wide variety of frozen foods to be accommodated. Occupying such a small floor area, there is room in your business for a Shanklin cabinet.

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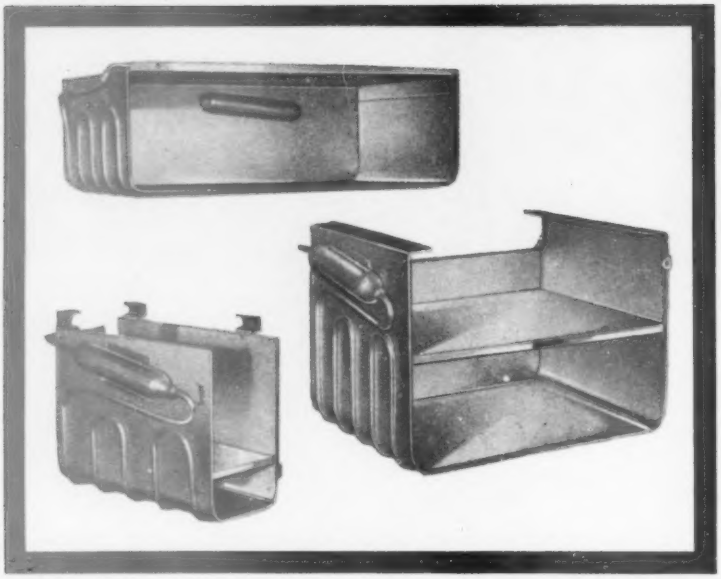

ALUMINIUM EVAPORATORS

Manufactured by an ingenious and economical process ensuring CONSTANT VOLUME, which EVAPORATORS LIMITED have developed and proven over several years of service.

ANY SIZE MADE TO ORDER

and over 20 standard models available to meet immediate requirements

Aluminium has demonstrated its superb qualities in many amazing ways but nowhere has it been put to use more compatible with its unique qualities than in this appliance.

Aluminium Evaporators are lighter in weight, have better heat transference, will neither rust nor flake.

It must also be noted that Aluminium has wonderful hygienical properties where safe food storage is of the utmost importance.

Whatever shape or size domestic Evaporator you may require, we can very quickly meet your exact requirements : in design and service EVAPORATORS LIMITED offer you the best.

NO EXPENSIVE TOOLING COSTS.

NO LONG DELAYS.

ALL ALUMINIUM EVAPORATORS SUPPLIED COMPLETE WITH ALUMINIUM TO COPPER CONNECTORS.

EXTERNAL DIMENSIONS				
Model No.	Width	Height	Depth	Remarks
EL 108	10″	9″	12⅛″	Refrigerated Shelf
EL 173	6¾″	9″	11¾″	Loose Shelf
EL 440	6¾″	9″	11⅞″	Refrigerated Shelf
EL 360	20½″	8⅝″	12⅝″	Refrigerated Shelf
EL 570	16⅝″	10 11/16″	1	Refrigerated Shelf
EL 266	16⅝″	10 11/16″	13″	No Shelf
EL 177	6¾″	8 1/16″	10¾″	Loose Shelf
EL 1020	8 1/16″	5 5/16″	10″	No Shelf
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77

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Applicants should write to the Company Personnel Manager quoting reference 328, T. Wall & Sons (Ice Cream) Ltd., 59/61 Park Royal Road, London, N.W.10. 68

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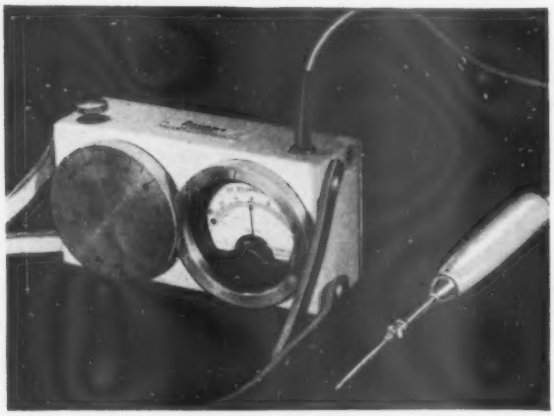

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and ICE AND COLD STORAGE

Established 1898

VOLUME 63 NUMBER 751

OCTOBER · 1960

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Editorial . . . .

The Government's Pledge on Stores

Nitrogen Freezing Finds Favour

Variety Reduction

● An impassioned plea to the Government not to go back on its 20-year-old pledge concerning the wartime-constructed cold stores was made by Mr. Eugene Ruddin, president of The National Federation of Cold Storage and Ice Trades, at its annual luncheon in London last month. Readers will recall that the 1939 emergency caused the Ministry of Food to commission the building by the Ministry of Works of 47 cold stores, of from 250,000 c.ft. to 1,000,000 c.ft. in size, strategically placed to avoid being targets for enemy bombers. This new 15,000,000 c.ft. of refrigerated space represented a 40 per cent. increase on the commercial capacity of the country and was patently a peacetime threat to the livelihood of the long-established operators who had served the nation well since the turn of the century. The writer was present at the luncheon organized by the old British Association of Refrigeration (now The Institute of Refrigeration) when Sir Henry L. French, permanent secretary to the Ministry of Food, gave the promise, in a three-point guarantee, that the Government Stores *would never be used in competition* with the commercial stores nor would they be disposed of on the open market.

● MODERN REFRIGERATION was not slow in publishing this pledge in its next issue and thereby set the seal on a promise which up to this date has saved the cold storage industry from a calamitous situation.

● It is now common knowledge that the Government is contemplating placing these stores on the market for disposal, despite the fact that the Rt. Hon. Heathcoat Amory, then Minister of Agriculture, and Dr. Charles Hill are on record in *Hansard* declaring their belief that this pledge should be honoured.

● Key to the success of liquid nitrogen freezing of foodstuffs, mentioned briefly last month, is the exceedingly rapid cooling rate (a few minutes compared with up to 24-hour freezing periods for conventional methods). As a result of this fast cooling, there is no time for osmotic pressure to build up inside the food cells and burst them. Further benefit is ascribed to the displacement of oxygen by means of nitrogen. The effectiveness of such oxygen removal in improving shelf life is well established and the principle is used in the packaging of Tropicana frozen orange juice and of Chase & Sanborn pressure-packaged coffee, among others. On a modest scale, liquid nitrogen freezing is already employed by the U.S. military for shipping foodstuffs from the United States to France, Germany, and to the Azores. Using large insulated containers for this purpose, the method has been under investigation for two years, and has resulted in substantial savings over conventional refrigerated shipping.

● For commercial shipment, liquid nitrogen refrigeration is still being tested. For over a year Liquefreeze Co., who has been shipping all imaginable types of food over most of the United States using two 40-ft. truck trailers and one converted ice-and-salt railroad car, expects to have a new railroad car constructed in which foamed plastic insulation boards replace the steel conventionally employed for walls, floor and roof. In the construction of these cars a main problem to overcome is the thermal contraction exhibited by all insulating materials when cooled to –320° F., the boiling point of nitrogen. One solution approved by railroad engineers of Pacific Fruit Express Co. for structural soundness, has been the use of insulation boards which are loaded by external springs to take up thermal contraction and to hold the panels together during heaving of the cars. Typical panel thickness is 6 in. on ends and sides, 8 in. on ceiling and floors. A well is provided in the car bottom to hold a pool of liquid nitrogen which is gradually evaporated in the course of shipment, thus giving up its cooling effect to the car and its contents. In one recent test run, a car containing 61,000 lb. frozen vegetables was shipped the 3,000-mile distance from California to New York, arrived with an average temperature of –124° F. For future commercial runs, higher arrival temperatures are anticipated, thus calling for reduced consumption of liquid nitrogen. For the food processor, liquid nitrogen refrigeration is a development being watched. If economics live up to the optimists' expectations, it could become a means for expanding the line of frozen foods, for simplifying food processing operations, and for extending the competitive shipping range of food processing plants.

● A most entertaining and purposeful little booklet entitled " Do you need a refrigerator ? " has been published by The Domestic Refrigeration Development Committee. The purpose of this booklet has been to highlight in an easy and readable way the main questions so often asked about refrigeration by both owners and non-owners of refrigerators, and to explain the importance of domestic refrigeration in the modern home. This booklet is available at 6d. per copy, including postage, from C. S. Services Ltd. at 5, Carlos Place, London, W.1 ; orders for 500 copies or more will be supplied at the rate of 4d. each.

● To sell their products to satisfied customers at competitive prices is the aim of most firms. Prices must, at least, be stabilized and reduced whenever possible. To achieve this, production costs must

be kept down without sacrificing standards. That means high productivity through increased efficiency and the elimination of wasted materials and effort. One sure way to that end is "variety reduction." This does *not* mean merely restricting the customer's choice. It *does* mean producing what the customer is willing to buy. In the British Productivity Council's new booklet "Variety Production" are given many examples of how this can be achieved. A case is quoted from J. & E. Hall's who make a wide variety of components in small batches to serve the firm's two main lines of production—refrigeration, and lifts and escalators. The two lines are served by separate drawing offices, with different drawing and issuing systems, but all products pass through a common manufacturing organization, with common stores and stock control departments. Before a policy of variety reduction was introduced, four stock catalogues were used, one each for refrigeration mechanical lifts, electrical lifts and escalators.

● When preparing drawings for new products, draughtsmen and designers were spending much time searching through the stock lists for some part they knew existed but could not readily find, it is revealed. If after a while it could not be found, they would design or buy-out a new item, which would then be added into the stock lists. The description of this item by the designer might be, for example, a "hinge stop"; it was, in fact, a round pin. Hundreds of pins were listed under 60 different names; a pin used on one component was termed a "governor pin" while an identical one used in another assembly was called a "stock pin." It was evident that something had to be done. It was decided that a new catalogue must be compiled embracing all activities. A firm of consultants was called in, and introduced a system of classification and coding; the work took two years to complete, the firm's technical staff working in close liaison with the consultants the whole time.

Refrigerator Stocks Still Rising

DESPITE efforts to boost sales by price-cutting, stocks of unsold refrigerators are still rising. Manufacturers and dealers are believed to be holding some 50-75 per cent. more refrigerators in stock than they were at the beginning of the year.

In July, according to figures issued last month by the Domestic Refrigeration Development Committee, about 98,000 British-made refrigerators were delivered to the home market. Although this is an increase of 6.6 per cent. over July of last year, it compares with an increase of 18 per cent. in June and of 45 per cent. in the first six months as a whole.

It is possible that the rate of deliveries will slow down sufficiently for the rest of the year to allow stocks to return to more normal levels—though this is little consolation to the manufacturers, many of whom are working well below capacity. There has certainly been a marked fall in imports, which in the earlier months were partly responsible for the inflated volume of stocks. Imports reached a peak of 36,000 in March, fell to 22,000 in June, and in July were less than half as large as in July, 1959.

The biggest question-mark concerns the actual level of retail sales, about which there is little reliable evidence. Comparison with 1959, when about 800,000 refrigerators were sold to the public, are complicated by the pre-Budget lull in that year, and the sharp increase in sales after the Budget. This year, the public bought an unusually large number of refrigerators in the first quarter, on the correct assumption that economic conditions were likely to get worse later in the year, and post-Budget sales naturally suffered as a result.

For the year as a whole retail sales should show a substantial increase over last year, but, thanks to the hire-purchase restrictions and the bad weather, it will not be as large an increase as the more optimistic manufacturers had bargained for.

The weakness of the home market has at least made possible a substantial increase in exports—in the first seven months they were 42 per cent. higher than in the same period of last year—but even this increase has not been enough to keep all the factories busy.

John Thompson (Wolverhampton) Ltd. in Refrigeration

As a step towards expanding refrigeration activity in South Africa to other parts of the world, John Thompson (Wolverhampton) Ltd. have decided to form a refrigeration division based on the main group of factories in Wolverhampton. Here, good facilities exist for all phases of heat engineering and refrigeration, including research, design, fabrication, testing and installation of pressure vessels, heat exchangers, pipework and instruments.

The Government and The Store Pledge

"Many of us are aghast at the facile manner of the Government in which it has suggested breaking its pledges to the cold storage industry," declared Mr. Eugene Ruddin, C.B.E., at the annual luncheon last month of The National Federation of Cold Storage and Ice Trades in London (*see also opposite page*).

"Some two years ago at a similar luncheon, I referred to a rumour that this was a possibility—we have now learnt during these past few months that that rumour was certainly no lying jade. This position has arisen at a time when the storage situation in this country is quite deplorable, and this is a situation that could well continue for some time. I sincerely regret therefore that I must once again refer to this grave business (*full report next month*).

NEWS OF THE MONTH

Refrigeration and A-c Exports.—During August, 1960, air-conditioning and refrigerating machinery (commercial and industrial sizes) to the value of £592,574 weighing 846 tons, was exported from the United Kingdom. Comparable figures for August, 1959, were 854 tons, worth £597,085.

* * *

Exports' Analysis.—Of the 846 tons of air-conditioning and refrigerating plant worth £592,574 exported by Great Britain in August, 1960—quoted in the preceding paragraph—27 tons went to the Union of South Africa, 24 tons to India, 82 tons to Australia, 19 tons to New Zealand, 700 tons to Canada, 160 tons to " other Commonwealth countries," 56 tons to Eire, 18 tons to Sweden, 152 tons to Western Germany, 58 tons to the Netherlands, 13 tons to Belgium, 14 tons to France, 20 tons to Italy, and 126 tons to " other foreign countries."

* * *

Refrigeration Plant Classified.—Of the total exports of air-conditioning and refrigerating machinery during August, commercial refrigerators accounted for 69 tons, worth £44,072, industrial plant and equipment for 199 tons worth £95,532, and refrigerating machinery, equipment and parts for 368 tons, worth £280,419.

* * *

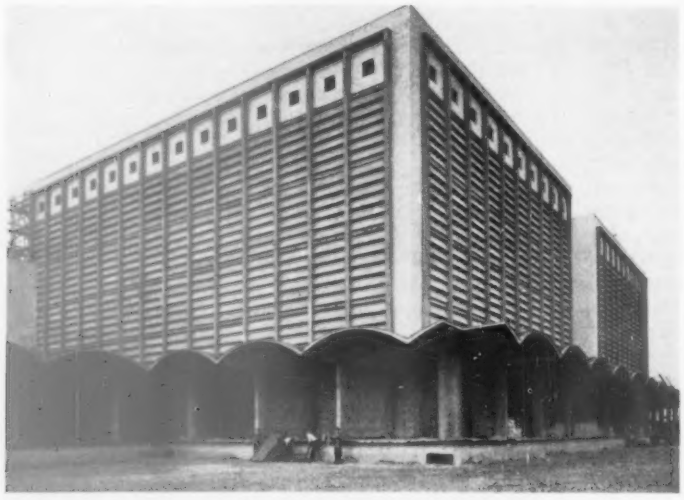
Exports of Small Refrigerators.—During August, 1,296 tons of complete refrigerators and domestic refrigeration equipment were sent overseas from Great Britain. These exports were worth £770,749. The 1,296 tons comprised 42 tons to the Union of South Africa, 35 tons to Rhodesia and Nyasaland, 21 tons to India, 84 tons to New Zealand, 572 tons to " other Commonwealth countries," 42 tons to Sweden, 67 tons to Western Germany, 11 tons to the Netherlands, 2 tons to Belgium, 14 tons to Italy, and 403 tons to " other foreign countries."

* * *

U.S.A. and European Research.—In response to a long-felt need on the part of a number of American manufacturers with international interests, Northern Research and Engineering Corporation has begun the formal operation of a research and development office in London, England. The office which opened in July is under the direction of Dr. D. G. Wilson, resident technical director. The Northern Research and Engineering Corporation conducts both research and development and industrial consulting in heat transfer, thermodynamics, fluid mechanics and related technical marketing. A large portion of its work has been concerned with environmental conditioning and auxiliary power systems for aircraft, missiles and space vehicles. The company also performs work for a number of diverse industries, such as chemical processing, cryogenics, engines and turbines, and electronics. The new branch office will perform applied research, product development, and related technical market research and provide technical liaison services for both American and European clients. It is also believed that the London office will open new markets for R. & D. and technical market services as an increasing number of European concerns turn to consulting organizations for assistance.

* * *

New Rental Plan.—A.E.I. Hotpoint have introduced a rental plan for their major appliances in conjunction with Mercantile Credit Company. This is a major step forward in domestic appliance marketing, taking effect at a time when credit restrictions have imposed a curb on the expansion of the industry and on raising the standard of living. The plan is open to all Hotpoint dealers. An initial deposit of 13 weeks' rent is required and thereafter a weekly rent is charged by the dealer varying between 6s. and 12s. according to the type of washing machine or refrigerator required. This reduces after three years to a nominal weekly figure to cover service costs.



This new 6,600-ton cold store, just completed at Miskolz, north-east Hungary, has an elegant appearance not usually found in this type of building.

HIGH VACUUM TECHNIQUE IN FOOD PROCESSING

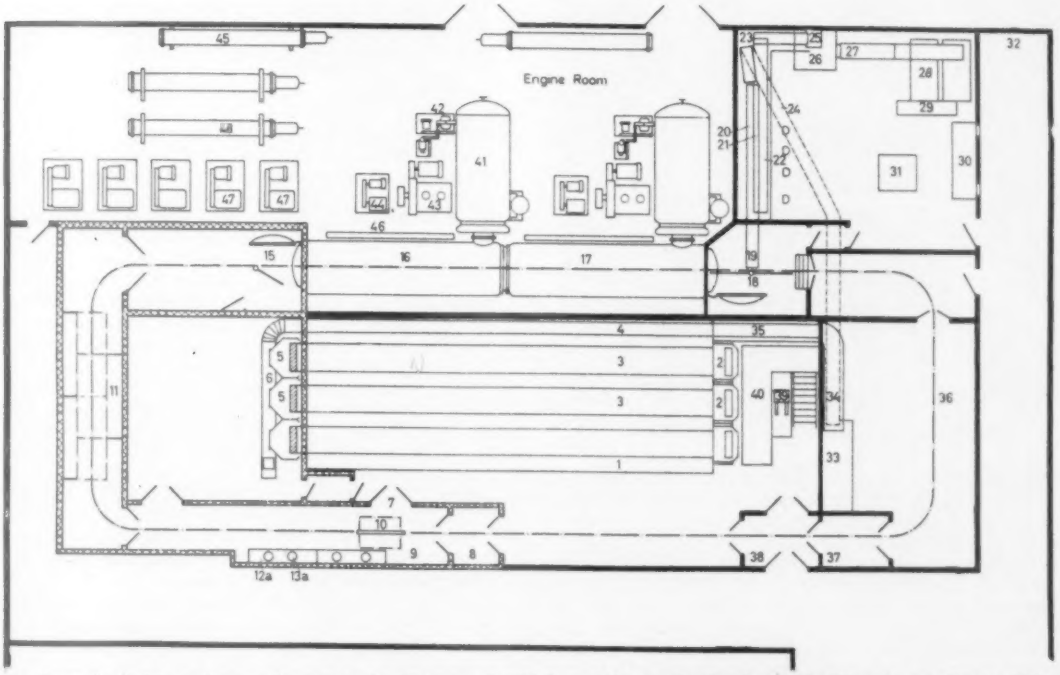
A CONFERENCE was held at Skyways Hotel, London, last month, by Leybold-Elliott Ltd., a member of the Elliott-Automation Group, on high vacuum process plant for all fields of industry. Of special interest to the refrigeration industry were the freeze-drying plants.

Mr. T. E. Days, sales manager, Leybold-Elliott Ltd., addressed the conference and described the company's products.

Dr. G. W. Oetjen, director of Leybold-Elliott Ltd. and of the German associated company, Leybold Hochvakuum-Anlagen G.m.b.H., recently presented two papers before a Chicago conference of the Food and Container Institute of the Quartermaster Corps on freeze-drying food materials "There is no doubt that pre-freezing a product and then freeze-drying will be more expensive than just freezing under vacuum and drying the product simultaneously in the same equipment. But even if one and the same product is frozen in the vacuum chamber there can be a substantial difference in quality as well as in drying time," stated Dr. Oetjen. "If, for example, cauliflower is frozen in the way of the dotted line in Fig. 1. (*not given* here) after some 45 minutes already 30 per cent. of the moisture content will have evaporated, but you can observe some deformed parts on the dried cauliflower. If the process is carried out as the other line shows, the total amount of ice evaporated might be only 20 per cent. in the same time. But the material is very quickly frozen and no such deformations can be observed. Therefore, the total drying time of the first procedure is shorter than the second process and therefore the throughput of the same equipment can be larger. The question is only whether the difference in quality of the product can be accepted for the specific purpose.

"Since the removal of the last few per cent of ice is always a long and time-consuming operation, the required residual moisture content also influences the total cycle considerably. Therefore—besides the difficulty of determining the residual moisture content accurately—any cost indication of any product has to state the moisture content of this product.

"Any equipment used today for freeze-drying will consist of the vacuum chamber, in which the product is dried, means for removal of the water vapour and some vacuum producing devices. There is no doubt that a plant using steam ejectors will be lower in investment costs than a unit using condensers and vacuum pumps. But the decision as to which design is preferable depends first of all on the cooling water temperature available and secondly on the prices for electricity, steam and water. Furthermore, this decision depends on the lowest ice temperature which should be obtainable in the equipment, and therefore no general single formula can be given for this question."



Layout for a Leybold continuous freezer, main features of which are the work chamber (16, 17), the condenser (41), the refrigeration system (42), and the vacuum pump system (43, 44).

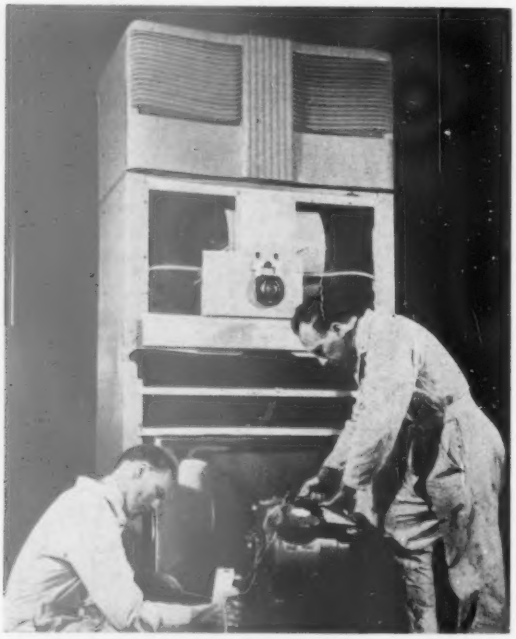
Growing Acceptance of Air-Conditioning

By J. D. F. PERRY

Industrial Editor of " Engineering "

ONE of the forecasts most often heard in British manufacturing industry at the moment is that of a sweeping advance in the utilization of air-conditioning. The reason given is usually one of three : first, the urgent necessity that every man on the factory floor and in the office shall be as productive and efficient as possible ; secondly, the exacting demands of new industries such as the electronics industry where delicate operations need controlled air conditions.

By no means the least often heard, the third reason, is the sharpening of competition to provide packaged



Carlyle packaged water-cooled air-conditioner.

air-conditioning equipment. Such equipment could lead to a revolution in the use of air-conditioning machinery in the United Kingdom because industry can now be offered a range of standard plant which, for obvious reasons, has many advantages over the individually tailor-made installations.

Not only in the industrial and domestic building field has the need for air-conditioning been proved and progressively applied, but in the transport field both in ships and on railways around the world, air-conditioning is becoming an established amenity. The Midland Pullman train from Manchester to London is fully air-conditioned. This is the first fully air-conditioned train in the United Kingdom.

Increasing Competition

Competition has been growing since the arrival on the scene of the Carrier Corporation of the United States, the largest makers of air-conditioning and refrigeration equipment in the world. With the British group, Stone-Platt Industries, who have major interests in road, rail and ship refrigeration and air-conditioning, Carrier Corporation towards the end of last year formed the Carlyle Air-Conditioning and Refrigeration Company in London.

The opinions and beliefs of the air-conditioning engineers from the United States, the home of advanced air-conditioning development, are highly relevant to the way this industry is likely to progress in the United Kingdom.

Of the need for increased production from each man and machine there is no lack of evidence. In his recent talk to leading businessmen Mr. Macmillan, the Prime Minister, repeatedly emphasized that reaching the necessary higher levels of British exports was mainly a matter of many people making that little extra bit of effort. The problem is where the effort is to come from. The shortage of skilled men has up to this moment been growing worse. That leaves the well-recognized need for higher productivity. This is not only to be met by better training and more skilful incentives ; it is also a question of conditions of work, and it is here that air-conditioning comes into the picture.

There are a few factories where the building is small enough, or the heat given off by the machines and the men operating them sufficiently limited, for the natural flow of air to be either adequate or of acceptable temperature. It is commonplace to find winter heating by oil or coal, and ventilation, only very casually related to humidity control, just non-existent. Yet it has been shown that controlling the temperature, humidity and flow of the air circulating in works or offices all the year round is not just a way of keeping the place cleaner, but improves efficiency to a measurable degree.

At a time when increased output from Britain's factories in order to reduce delays on deliveries, is perhaps the most urgent single requirement, any supportable facts on doing a better job are worth study. The studies of air-conditioning's effect on production carried out by the United States General Services Administration, a government agency responsible for the operations in 74,000,000 square feet of industrial space, show what can be achieved.

The General Services Administration took for its experiments two large office spaces where in the course of the year thousands of clerical searches were conducted. In every respect except one, the two areas were identical as to lighting, paintwork, arrangement of equipment and numbers employed. In each area there were 70 people, alike as to ages and the numbers of men and women. But only one area was air-conditioned.

Labour Aspect

After five months of work, in which exacting checks were made on rates of work, errors and absenteeism, the results were analysed. The output of work in the air-conditioned office was nine per cent greater. The effect on absenteeism was also marked. The non-air-conditioned area had two and a half per cent. more absence than the air-conditioned space. This was after all cases of absence due to causes in no way influenced by air-conditions, accidents and so on, had been eliminated. This, of course, may be on the conservative side. There is not much doubt that one of the enthusiasts of air-conditioning would claim that the person going home tired and stale after a day in unsatisfactory conditions of ventilation is more likely to become an accident victim than his opposite number leaving an air-conditioned plant.

The American experiment also showed that under the conditions of controlled air errors had fallen by almost one per cent. Not surprisingly there was a definite reduction in what those working in the air-conditioned space had to spend on the cleaning of clothes and, for the women on having their hair done and on make-up.

Those United Kingdom employers who in the hot summer of 1959 had strikes on their hands because it was " too hot in the works " would presumably agree with the general North American experience that air-conditioning is good policy in relation to labour problems. The situation there has moved on from the days when conditioning was a good thing to have.

It has instead developed to the position where a skilled worker being interviewed for a job may well ask if the factory is properly air-conditioned, as is the case in the United States today.

Skilled men are actively sought after in Britain. As the number of cleaner, more comfortable air-conditioned works grows in the United Kingdom the ability to claim—" We are air-conditioned, of course "—may have more than a little effect in attracting the right sort of man. This applies just as forcibly to office staff as to the men in the works. The state of a London office after the windows have mistakenly been left open all night is some indication of what the assault of dirt by day, when there is enough movement of papers and people for it to be unnoticed, must really be like.

It is one of the more obvious facts of air-conditioning that it reduces laundry bills. Another way of putting this is that shirts probably go into the washing machine just as often, but they have much less need to, as cuffs and collars do not get so dirty.

For office people, and to a rather less extent for factory workers, post-war architectural fashions have sharply heightened the desirability of air-conditioning. A wide sheet of glass overlooking the Thames, or a London square, may be imposing and even impress the visitor, but for several months of the year it may be extremely unpleasant to work behind. On a by no means cloudless day the sun may easily raise the room temperature appreciably higher than outdoor shade temperatures. Under these conditions more attention is centred on rolling up sleeves and mopping the brow, than on the affairs of the organization that allows these conditions. In the winter the rapid heat loss of a picture window will defeat the efforts of even a very costly radiator.

This is where the all-the-year-round principles of the disciples of air-conditioning in the United States apply most strongly. There is a basic economy of work that shows itself in the costs by warming through controlled air-distribution in the winter months and putting the same equipment into reverse to take the excessive heat in the summer, still with the same machinery governing the humidity.

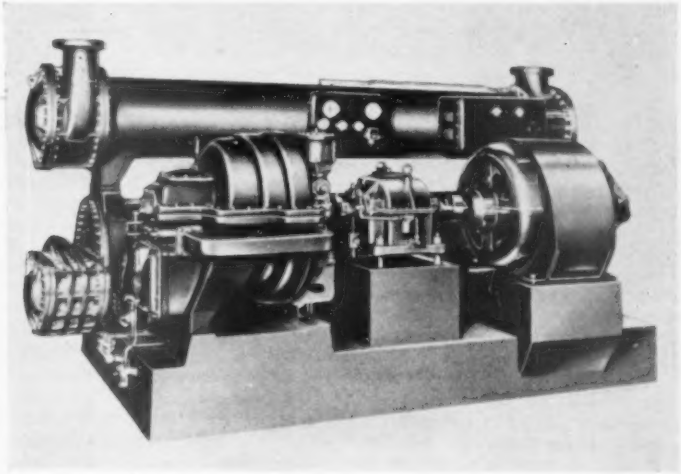
Potential

Around London and the provincial centres there is a planned volume of new office building, incorporating many millions of square feet of office space, all to be built in the next few years. So much of this space is to be behind large windows that the potential for air-conditioning equipment is plainly substantial.

Ever since 1836 when Dr. Reid attempted to introduce artificial humidifaction into the House of Commons the need for controlling air for human comfort has been recognized. Reid's method was to filter air through a veil 42 ft. long and 18 ft. 6 in. deep and to introduce the air into the chamber through nearly a 1,000,000 holes in the floor.

The recent survey among 87,000 clerical workers by the Institute of Office Management shows rising salaries, and accordingly status, among office workers, who should find it increasingly easy to put their need for improvements in conditions before their employers.

A Bill may be presented before Parliament in the near future based on the Gower's Committee report which was



Carlyle centrifugal refrigerating machine (125 - 1000 tons capacity).

presented to the Labour Government in 1949. The report called for sweeping changes which would revolutionize the working conditions of millions of city workers. Offices, for example, the report said, should have a high standard of fresh air ventilation, light and a minimum space of 400 c.ft. for every person employed. Improving efficiency, especially in industry, is not solely concerned with changing the air in an entire building. Some factory operations produce conditions where a limited number of operatives—or even one man—require cooling down if, to put it no higher, the employee is to be kept happily at his work.

The steel industry provides a good example. Air-conditioning an entire steel works, or an iron foundry, would be something more than a standard assignment. But the man who has to stand in front of an open furnace door wants something done for him. The answer to this is air-conditioning the particular worker—spot cooling. It amounts to directing a stream of cool air at the man on the hot spot. There are other less easily outlined examples of this sort of thing, and as the spot cooling solution is applied to one the word gets around and increasingly similar conditioning is called for by workers in other fields.

The United States, with its advanced penetration of air-conditioning equipment, is able to provide cases where businesses have been kept alive and enabled to prosper by the introduction of specialized air-conditioning applications. The use of air-conditioning in the unique American " dining-cars," railroad dining coaches bought brand new and put straight down beside the highway to serve the passing traveller, showed its adaptability in a corner where money was tight.

With the filled places and busy cooking stoves of the first dining-cars came a threat that the whole idea would cancel itself out, because of the great heat inside the coach. Air-conditioning engineers looked the problem over. They found that to circulate cooled air around the whole coach would cost considerably more in the installation of the equipment than the car had cost.

The answer, after much argument and wasted calculation, was the inspiration that now spot-cools the blast furnace man. Cooled air was blown along the line of customers sitting up to the serving bar. The benefit to those sitting farther away from the bar, and so farther from the cooking stoves, was incidental, but it was enough to keep them happy. It was also enough to keep the coach caterer in business and for the roadside diner, now at great cost with every possible refinement, to spread all over the United States. In Britain and the Commonwealth known and expected plans for new factories indicate the size of the expanding market for air conditioning equipment.

Electronics

Electronics could scarcely exist without efficient air-conditioning. Transistor production and the assembly of miniaturized equipment are functions in which airborne dirt has to be reduced to a minimum. The activities of all the instrument and control makers are in the same category.

Since computors need air-conditioning, their expected enormous expansion into every kind of industrial application will serve as an introduction for air-conditioning equipment in those parts of the world lagging in its application.

A glance at one of the key companies, Elliott-Automation, which has for some time been adding six new divisions a year to its organization, shows how fast is the growth of the electronics industry.

It may be possible to go too far in identifying certain fields of industry as the big growth possibilities for air-conditioning. That was not how it worked in the United States. Air-conditioning began there in 1902 when a young research engineer, the 25-year-old Willis Carrier succeeded in finding a method of controlling the humidity in a lithograph printing plant in Brooklyn. The eventual installation which was carried out at the printing plant is recognized as the world's first scientific air-conditioning system because of the addition of humidity control to ventilation. Authorities in this field now agree that air-conditioning must perform four basic functions. It must—

1. Control temperature.
2. Control humidity.
3. Control air circulation and ventilation and
4. Cleanse the air.

In the gradual acceptance of air-conditioning in the United States it was found that it was taken up not by types of industry, but rather by types of manager. The cost-conscious and the get-ahead executives took up year-round controlled air for their plants, whatever the industry.

The time-scale of the American air-conditioning development is something like this. From the first air-conditioning plant by Dr. Willis Carrier, one of the five founders of the Carrier Corporation, up to the depression of 1929 the industry was moving through the first " educational " phase. The total sales graph was a slowly rising one.

Then in the 1930s came the " acceptance " period, which was interrupted by the Second World War, when the best new plants had air-conditioning installed but the older works had to wait.

Now the United States air-conditioning industry has reached the " demand " period where it is smart for the housewife to be able to show callers her new split packaged equipment.

Britain in Educational Phase

Britain is still thought by visiting American industrialists to be somewhere in the educational phase. But this time the development could come very much sooner. In the United States of the 1930s very much air-conditioning equipment was custom built, to specifications worked out in the plant and paid for accordingly.

Now the greater part of the United States air-conditioning comes from packaged units, made to a very wide number of lines, and fitted to particular factory or office requirements by application engineers.

The anxious quest for greater production and profitability in the United Kingdom is a factor making for a shortening of the educational phases in this country.

An important change in the supply position to home and Commonwealth industry of air-conditioning packaged equipment took place late in 1959 when Carlyle Air-Conditioning and Refrigeration Limited opened its offices in London.

The company is backed on the American side by Carrier Corporation with its $8,000,000 a year research and development programme. Carlyle will market air-conditioning plant, manufactured in Stone-Platt factories, making use of Carrier Corporation's patents, techniques and know-how.

The first experiences of the Carlyle company in London have been instructive. Enquiries from countries including Africa and Scandinavia have outpaced those from Britain. It is obvious enough that it is more of a necessity to air-condition a works in Nigeria, where the climate if not ameliorated can bring work to a complete dead stop,

than it is in Manchester where it will simply be uncomfortable, and where the losses are not actually seen.

If the joint enterprise between Stone-Platt and Carrier Corporation finds a widening range of its plant going overseas then the authorities in Britain are unlikely to complain.

But it is not only in the hot climates of the Commonwealth that air-conditioning practice is far ahead. The Scandinavians, who have good reason for not wanting to throw open windows for more than six months of the year, have put temperature, humidity and ventilation control together in a wide variety of applications.

Underground Generating Plants

A particular Norwegian problem has been the number of electricity generating plants built underground. These plants are far into the mountain rock and air-conditioning is the obvious answer. Its presence in the generating stations has proved contagious. For good reasons, including defence, general engineering works are also to be found deep in the rock, all of them making use of air-conditioning.

Developing along the United States pattern the engineers in these Norwegian plants have taken their liking for air-conditioning home with them and put it into effect. Will the same thing happen in the British domestic market?

On its home base in the United States, the Carrier Corporation devotes over half of its productive effort to the householder.

The advantage to the household is not difficult to find. Even the English summer has plenty of days when the humidity has reached the "sticky" point, when rooms with the sun on them are too warm, or when the evening has a nip in it. Anyone of these are ideal conditions for correction by central heating.

The use of basically one set of equipment for winter warming and summer cooling, plus the humidity control, is one of those habit forming practices. While slow to get a grip on the United Kingdom home market it could move up very swiftly into the position of carrying status and being a sign of keeping ahead.

The cost is both less than is often thought and more than some people think it ought to be.

But the electricity consumption is every bit as important as the installation costs. The position here is not so rosy in Britain as it is in the United States. There the power companies want to increase their base load; at the mention of the word "heat pump" they are more than ready to present the householder with forms for specially reduced electricity charges.

However, the manufacturing capacity is now in this country, with a great range of packaged equipment. It remains to be seen how many industrial concerns will be experiencing the benefits of lower production costs, greater worker efficiency and a better end product through proper air-conditioning, and how many housewives five years from now will have air-conditioned homes and how many will be content with just keeping the place warm.

REVIEWS

Thermodynamics. By GORDON J. VAN WYLEN. xxiii + 567 pp. 9 in. × 6 in. plus one fold-out chart with 260 figures and 21 tables in text and 11 tables of properties in appendix. Chapman & Hall, London. 64s.

This new work on thermodynamics by a departmental chairman of the University of Michigan is a textbook with a difference. It has evolved from the challenging and stimulating experience of writing supplementary notes for students, and it combines a rigorous treatment of fundamentals with a distinctly engineering perspective. The author hopes that a study of the book over a period of 30 weeks during the undergraduate stage or equivalent will enable one to tackle the majority of engineering problems that require a thermodynamic analysis from atmospheric air, through power plant, refrigeration, and gas turbine to the liquid-propellant rocket. No fewer than 120 examples are given and 308 problems are set in the various chapters, with answers in an appendix to each third problem.

Bourdon tube pressure and vacuum gauges—B.S. 1780 : 1960

Prepared by a committee of experts, this new publication (60 pp., 18 illustrations) specifies requirements for indicating pressure gauges, vacuum gauges and combined pressure and vacuum gauges of the bourdon tube type. The range of nominal sizes is 2—12 in.; and the maximum scale readings are up to 16,000 lb. per sq. in or up to 6 tons per sq. in.

Requirements are specified for test gauges with concentric scales and for industrial gauges with concentric and eccentric scales. The standard gives a range of sizes for direct mounting and surface mounting gauges; and a series of standard pressure ranges and scale graduations.

Among the seven sections of the comprehensive volume are those dealing with: materials and construction; dimensions; accuracy; testing and inspection; marking and packaging. Buyers and suppliers will find particularly useful the list of 18 items of information which should be embodied in an order.

Helpful appendices. The new standard concludes with nine appendices. Typical titles are "Notes on testing apparatus and methods" and "Recommendations on the installation and use of gauges."

Copies of this standard may be obtained from the British Standards Institution, sales branch, 2, Park Street, London, W.1. Price 15s. (Postage will be charged extra to non-subscribers).

BOTTLE COOLERS BY AIR

Faced with the necessity of sending a consignment of bottle coolers to Ireland for a promised delivery, and in the face of the recent shipping strike, Heat Pump and Refrigeration Ltd., Landsdowne Lane, Charlton Village, London, S.E.7, chartered a special plane to "deliver the goods." The bottle coolers were destined for the Guinness plant in Ireland.

Growing and Processing the Crystal Element

Crystal growing chambers with control panels.

The delicate process of crystal growing demands carefully regulated conditions, with special attention to temperature control.

GIVEN impetus by the demands of war, tremendous advances have been made in the field of electronic instruments for measurement, detection, observation and communication, and the greatest contributory factor in these changes has been the development and use of the crystal.

The crystal element has made possible the creation of new instruments of great accuracy and sensitivity, at the same time reducing the size and weight of existing instruments by the elimination of bulky components previously necessary.

The power of the crystal is in its ability to generate electricity by the external application of pressure or by twisting and bending motions. This pressure electricity, or "piezotronics," was first discovered by the Curie brothers in 1880. Experimenting with quartz crystal they were able to measure electricity charges produced when weights were placed on it. The opposite effect, the dimensional change when voltage was applied, was also observed and measured.

Probably the most common peaceful use to which the crystal element has been put is the record player pick-up. The crystal element in the head or cartridge of a pick-up is directly coupled to the stylus, and as it follows the irregularities of the groove of the revolving record, certain movements or strains are set up in the crystal. These are immediately transmitted in the form of electrical charges and carried to the amplifier.

The high tone quality produced through the modern pick-up head and the improvements made in the records themselves have created a great demand for this equipment, and it is principally the increased popularity of this form of entertainment which has been responsible for the rapid expansion of the crystal industry.

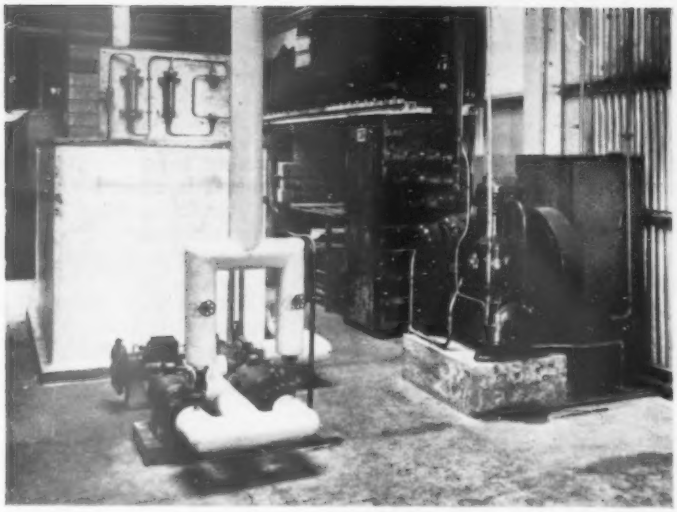
The crystal element is made from two small plates cut from large crystals which are grown in salt solution under rigidly controlled conditions. Of special importance is temperature control since the slightest variation can cause a complete breakdown in the process.

Brush Crystal Company Ltd., Hythe, Hampshire, who have specialized in the development and manufacture of crystals for a quarter of a century, have formulated a method whereby strict control can be kept on the temperature of the chambers during the entire period of growth. This is the only method employed in any commercial undertaking in this country and incorporates use of extensive refrigeration and heating plant supplied and installed by York Shipley Ltd. The first plant installed in this country was at Hythe in 1953 ; this has now been followed by further plant which has recently been completed.

Preparing the Solution

The first stage in crystal growth is the preparation of a solution of distilled water and sodium potassium tartrate, or Rochelle salt as it is commonly known. This is made up in a vat at an elevated temperature from where it is filtered through a press for the removal of any impurities. Absolute cleanliness is essential during these stages.

Measured quantities are then pumped into trays which are arranged on racks in growing chambers. At the bottom of each tray a number of recesses are provided, these receive the crystal seeds upon which



Part of the refrigeration plant including 7½ h.p. York condensing unit, tank and chilled water pumps.

the growth takes place. Hoods are placed over the trays to eliminate evaporation.

The finished product which grows from each seed is a single crystal, about 20 in. long, from 4 to 5 in. wide, 2 in. thick, and weighing approximately 5 lb. Its cross section must represent accurate geometrical proportions and it must be completely flawless.

When the crystals are fully grown they are removed from the trays and stored. The solution is returned to the vat, where the Rochelle salt lost during the process is made up, and prepared for the next growing cycle.

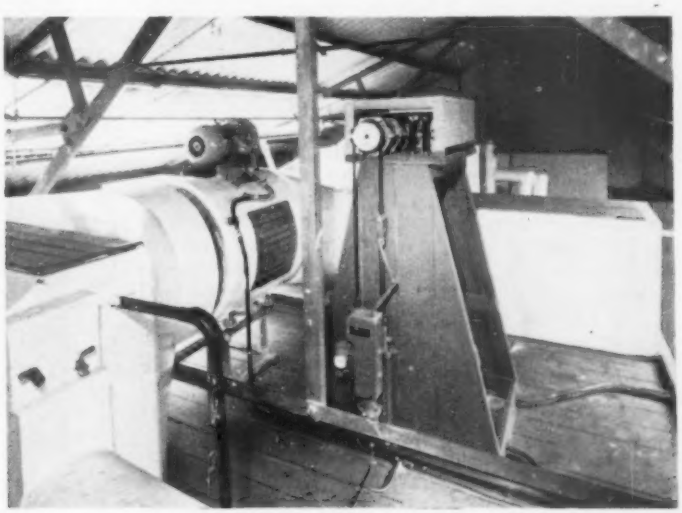
Temperature Control

The solution is introduced into the growing chambers at a slightly lower temperature than that attained during preparation, and this temperature reduction is continued at a carefully regulated rate throughout the period of growth.

The growing chambers are rooms insulated with corkboard. The refrigerating plant consists of three 7½ h.p. York water-cooled condensing units connected to steel pipe coils submerged in water tanks, chilled water circulating pumps, air compressors, Honeywell Brown control panels and pneumatic controls.

Each room is fitted with plenum chambers, trunking, finned cooling battery, chrome steel sheathed electrical element heater battery, air circulating fan and control panel. Each of the two water tanks is fitted with a control panel fully covering the required water temperature. This is achieved by tank thermostat and diaphragm operated mixing valve coupled to an electronic-pneumatic recording controller.

The rigid temperature requirements of each growing chamber are controlled by electronic-pneumatic time pattern transmitter and recording controller connected to a diaphragm operated chilled water valve, with piston-operated variable transformer on the heater battery. All the equipment is fully automatic and



Chilled water and electric heater coils mounted above chambers, with fan assembly. Heater Variac is in front with piston-operated controller.

room control panels are equipped with coloured indicator lights covering interrupter, fan, heater and chilled water circuits.

Cutting the Element

When the delicate process of growing is completed, milling machines and bandsaws cut the large crystals into slabs. Seeds for subsequent growings are cut from the crowns of these large crystals.

The slabs are cut into strips, certain angles of cut determining polarity, and coloured for easy recognition. The strips are then further reduced by bandsaws to unit size.

Strip thickness is reduced by surface milling. This is carried out on a circular table into which the strips are fitted. A vacuum holds them in place while they are carried under milling cutters.

A graphite electrode surface is next sprayed on to one side of the strip, or plate as it is now termed; a connexion lead is added, and a further plate cemented on top. The plates are then returned to the milling machine where the two outer faces are further machined.

Graphite electrode surfaces are sprayed on to both faces, a second connexion lead is applied and the whole element wrapped in silver foil and sealed with wax. For final protection the whole element is given several coats of specially prepared waterproofing lacquer and oven cured.

Before despatch, every Brush crystal element is subjected to rigorous inspection and test. This is carried out on a test bench where instruments measure insulation and capacity. When passed, they are then packed and despatched to users at home and overseas.

THE OTTESEN MEDAL

ENGRAVING of the first A. J. A. Ottesen medal was recently completed at the Royal Danish Mint. The medal was awarded to Dr. J. C. Fidler of the United Kingdom Agricultural Research Council

on the occasion of the 10th International Congress of Refrigeration in Copenhagen in August 1959. This was the first award of the medal. Since the medal itself was not ready at that time, it was presented to Dr. Fidler at a ceremony at the Danish Embassy in London by the Danish Ambassador, Count Steensen Leth.

The Ottesen medal was instituted by the Danish organizing committee of the 10th International Congress of Refrigeration to commemorate the work of the Danish inventor, A. J. A. Ottesen, who put into use the first generally adopted method for quick-freezing food. The medal will be awarded every 4th year, generally in connexion with the International Congress of Refrigeration. It will be awarded by a Danish committee to a person who is actively engaged in and has done outstanding work in the field of refrigeration science or technology.

The medal itself bears the following inscription: "A. J. A. Ottesen 1860-1936. En af kuldeteknologiens pionerer (one of the pioneers in the technology of refrigeration)—For Kuldens udforskning og anvendelse" (for the exploration and application of low temperatures and refrigeration). The ornamental pattern on the medal is an ice crystal similar to the one used in the seal of the 10th International Congress of Refrigeration. The medal is cast in gold. It was designed and sculptured by the Danish sculptor, Harald Salomonsen, of the Royal Danish Mint. Mr. Salomonsen is a student of the Academy of the Fine Arts in Copenhagen. He has exhibited sculptural works and medals in various European countries and was awarded a bronze medal at the International Medals Exhibition in Madrid in 1951.

"For the exploration and application of low temperatures and refrigeration."

Tubular Heat Transfer Equipment Lectures

THE National College for Heating, Ventilating, Refrigeration and Fan Engineering announces that a course of eight lectures on Tubular Heat Transfer Equipment will be given at the Borough Polytechnic, Borough Road, London, S.E.1, on Monday evenings commencing October 24 at 6 p.m.

Intending students should have a degree in chemical or mechanical engineering, a higher national certificate, some similar qualification or have had suitable experience.

The lectures will be particularly concerned with the thermal design of double-pipe exchangers, shell and tube exchangers, boilers, condensers, etc. and suitable for those engaged in the specification, selection and manufacture of equipment. Certain lectures will be delivered by specialists in particular aspects of design, operation, selection, etc. Duplicated copies of graphs and tables, etc. will be presented to students during the course, as needed, and it is hoped that printed lecture notes will be available.

Application forms are available from the Borough Polytechnic.

Mr. C. M. BRAIN RETIRES

WE feel sure that we speak for the whole industry when we wish a happy retirement to Mr. C. M. Brain, chief engineer of J. & E. Hall Ltd., after nearly half a century with that firm.

Mr. Brain joined J. & E. Hall in 1912 as an apprentice, but before completing his apprenticeship was selected by the late Dr. F. A. Willcox as his assistant, and remained closely in contact with him throughout the remainder of Dr. Willcox's career.

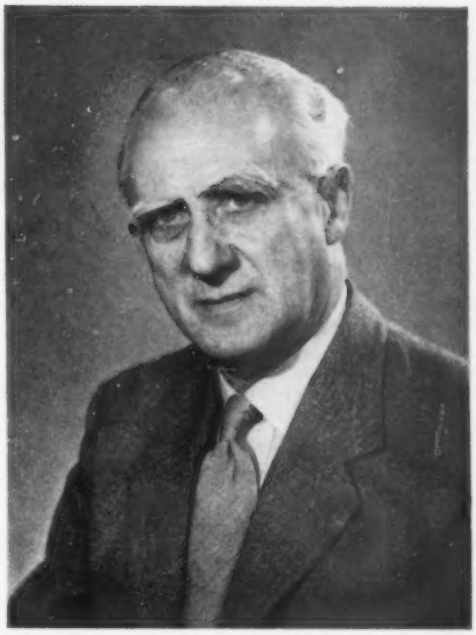
During his early years with the company Mr. Brain was seconded to work with the newly formed D.S.I.R. on the first work done in this country on the quick-freezing of foodstuffs. This dealt chiefly with fish and the work was carried out on a small plant in Billingsgate Market which was later transferred to the Low Temperature Research Station at Cambridge. He was also seconded for a time to work with Dr. Ezer Griffiths at the National Physical Laboratory where the plant was installed for the now classical work on heat transfer through insulating materials.

During the war years Mr. Brain took an active part in the development of many special applications of refrigeration such as freeze-drying of penicillin and human plasma and many other complicated applications requiring low temperatures and close automatic controls.

Up to the date of his retirement at the end of September, Mr. Brain held the position of chief engineer for the last 15 years and as such was responsible for the many technical aspects of the company's business, the education and training of all grades of apprentices.

Activities of an extra-mural nature brought Mr. Brain a very wide circle of friends in the industry. He joined the Institute of Refrigeration in 1930, contributing several papers and making frequent contributions to discussions.

As chairman of the Institute education committee he has taken a leading part in the preparation of the membership examination syllabus and was also chairman of the City and Guilds committee which dealt with their syllabus which was to become known as the technician's course. For three years he was chairman of the Institute Council. He represented the Institute on a number of B.S.I. committees and represents the B.S.I. on the International Standards Organization Committee on Refrigeration. He has been a governor of the National College of Heating, Ventilating, Refrigeration and Fan Engineering since its formation to the present day, and is now witnessing the coming into use of the new building in which it is hoped to start the present session.



Mr. C. M. Brain.

Mr. Brain became an associate member of the Institution of Civil Engineers in 1952 and a member of the Institution of Mechanical Engineers in 1948.

U.S. Training Committee.—A training committee was appointed at a recent meeting of the Air-Conditioning and Refrigeration Institute at Washington to devise programmes to increase the supply of qualified service and installation personnel. The committee, according to A.R.I. managing director, Geo. S. Jones, Jun., will help develop a programme for teaching air-conditioning fundamentals in public school systems at both the high school and night school levels.

A "Junior International Congress" in Marseilles

"M.R.'s" special shot of the port of Marse

"LES JOURNEES DU FROID" at Marseilles from September 5 to 10 constituted, in fact, a highly successful week's congress of refrigerationists from 22 countries and at those functions with the greatest appeal 400 participants were on hand. The "Association Francaise du Froid" and the "Institut International du Froid" were the organizing bodies, the latter, of course, drawing the international contingents from as far away as the U.S.A. and Russia for meetings of commissions 3, 4 and 5.

The civic leaders of that most interesting city of Marseilles shared in making the gathering a memorable one.

The event opened with a "national congress on refrigeration and marketing of fruit and vegetables" in the building of the new Faculty of Sciences. Reports and discussions occupied most of the opening day. The city fathers of Marseilles offered a cocktail party in the evening.

Meetings of the commissions 3, 4 and 5 took up three and a half days.

Interesting technical visits took place throughout the week and included trips to :—The Nimes and St. Cesaire wholesale meat market and abattoir ; the St. Andiol fruit packing station ; the port of Marseilles by water and to the Fraissinet Line's *Jean Mermoz* ; the Glacieres de Paris ice plant ; the "Sopad" factory and the Nice slaughterhouse.

The Marseilles Chamber of Commerce entertained the visitors at a delightful reception.

An informative visit was that paid to "Le Canet" factory of the Societe des Glacieres de Paris, a post-war plant standing on a 7-acre site a few miles out of Marseilles, turning out not only water ice but ice cream and iced lollies. Alongside the factory 60 railway wagons can be accommodated on four tracks.

The ice plant includes three tanks, one having a daily ice output capacity of approximately 165 tons, the other two of a daily ice output of approximately 130 tons, when operating at 23° F., in 56-lb. blocks.

Clear ice is obtained by means of low compression air being blown into the tanks by four air compressors.

In order to obtain a quick lowering of the temperature of the railway refrigerator cars, for which most of the ice production is destined, a conveyor takes the blocks to roof level where is situated a crusher ; thence, a rubber belt conveyor takes the broken ice to a hopper that has two inlet chutes overhanging the railway wagon loading hatches.

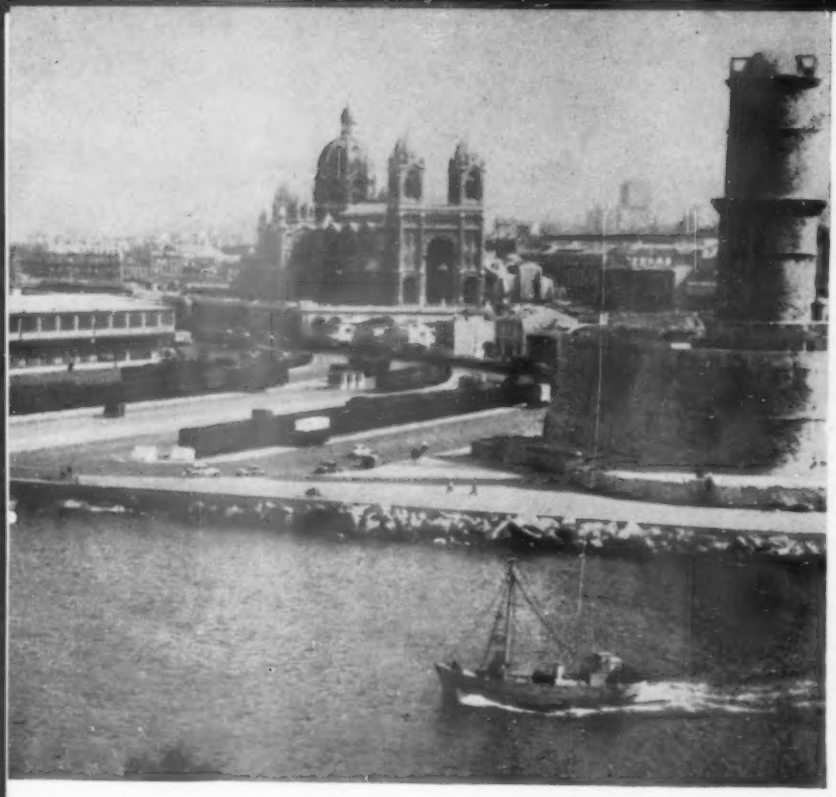
The ice intended for storage is led by a simple slideway into a handling room, the capacity of which is approximately 295 tons. From here, the ice can be taken to the loading bank for road transportation, or to the crusher mill when the ice is to be used on the railway. In the production hall are two concrete tanks, each of approximately 5,316 c.ft. capacity, containing a reserve stock of filtered water for ice production.

On its ground floor the plant has a cold storage hall extending over an area of 3,230 sq. ft. fitted with direct expansion ammonia coolers.

Two first-storey rooms, totalling 6,674 sq. ft., are equipped with air circulation and ceiling grids.

There are 12 ammonia compressors installed at this plant, as shown on a later page.

The party that toured the port were offered a delightful reception abroad the Fraissinet Line's West African luxury vessel *Jean Mermoz* of 14,200 tons. Strangely enough, in a ship belonging to democratic France, six classes of cabins are provided, namely, "de luxe," "priority and 1st class," "2nd class," "3rd class," "4th class cabin," and "4th class tweendeck." The vessel is fitted with approximately 35,000 c.ft. of refrigerated space and has air-conditioning applied to 1st and 2nd class cabins and to 1st, 2nd and 3rd class public rooms. Three "Loire" compressors of 220,000 frig. per hour handle the air-conditioning load while two compressors of 55,000 frig. per hour cool the food spaces.



es, with the imposing cathedral on the right.

Successful Meetings of the French Association of Refrigeration and the International Institute of Refrigeration

MARSEILLES ICE PLANT

On Ice Production Duty

2 " Bernat "-type compound compressors, *each* of 1,100,000 frigories per hour (fg./h) capacity	2,200,000 fg./h.	
2 " Brissonneau "-type compound compressors " DDV 25 " model *each* of 550,000 fg./h. capacity	1,100,000 fg./h.	
1 " Fixary 90 V2 " compressor	280,000 fg./h.	
		3,580,000 fg./h.

On Cold Store Duty

1 " Fixary 90 V2 " compressor ... ... and as an emergency :—	280,000 fg./h.	
1 " DDV 25 " compressor		
1 " DDV 21 " compressor		280,000 fg./h.
		3,860,000 fg./h.

On Ice Cream Production Duty

1 " DDV 21 Brissonneau " compressor ...	300,000 fg./h.	
2 " 12 WA Brissonneau " compressors ... and, as an emergency :—	700,000 fg./h.	
1 " DDV 25 " compressor		1,000,000 fg./h.
Total capacity of the installation		4,860,000 fg./h.

Those attending the Meetings in Marseilles were :

Algeria : Cardot, P., Oran ; Joly, Oran ; Kreitmann, Algiers ; Nerot, Oran.

Austria : Altmann, A., Vienna ; Steffan, K., Vienna ; Trachtenberg, H., Vienna.

Belgium : Foulon, J., Brussels ; Gerard, A., Nimy-lez-Mons ; Glansdorff, P., Brussels ; Gomez, P., Brussels ; Havaux, Brussels ; Hurrard, H., Brussels ; Jauniaux, P., Brussels ; Malengret-Lebrun, R., Nimy-lez-Mons ; Piret, F. A., Brussels ; Willick, M. E., Brussels.

Bulgaria : Stamen - Stoyanov - Stamenov, Sofia.

Czechoslovakia . Mraziry, J., Prague ; Petrmichl, J., Prague ; Potucek, B., Prague ; Vaneck, B., Prague.

Denmark : Hansen, N. H., Roskilde ; Jul, M., Roskilde ; Lorentzen, J., Copenhagen.

Eire : Harbord, F., Dublin.

France : Anquez, M., Paris ; Archimbaud, J., Marseilles ; Arvieu, A., Montauban ; Astier, A., Nimes ; Audema, M., Agen ; Bachmann, Paris ; Ballot, G. A., Paris ; Barjon, H. H., Paris ; Barral, Marseilles ; Beausejour, Toulon ; Bedue, A., St. Denis ; Bellanger, G., Asnieres ; Benezit, A., Paris ; Berthelemy, Lyons ; Bigourdan, G., Lyons ; Boiron, Paris ; Breton, Marseilles ; Bounous, Marseilles ; Caillet, L., Marseilles ; Calisti, Mme., Paris ; Caron, Nevers ; Castelli, Paris ; Charcosset, C. ; Chatain, Montpellier ; Chevallier, H., Paris ; Clement, P., Paris ; Clement, F., Orléans ; Colombani, Paris ; Conan, J., Nantes ; Corgier ; Cokelaere, Paris ; Daussy, R., Marseilles ; David, A., Paris ; Deau, J., Paris ; Decroix, M., Valence ; Delpech ; Devatine, Paris ; Dore, F., Mme., Paris ; Drouant, J., Paris ; Dullin, Paris ; Dumolin, Marseilles ; Duron, Paris ; Dupuy, Marseilles ; Elziere, R., Lyons ; Enjouvin, Marseilles ; Fabre, H., Nimes ; Faure, A., Paris ; Faverio, Marseilles ; Ferrari, J., Charenton ; Fontanel, Ch., Marseilles ; Fontaine ; Fouillaud, Arles ; Gac, A., Antony ; Gervais, Marseilles ; Gervois, Marseilles ; Gervois, Marseilles ; Girardin, P., Paris ; Girod ; de Grasset, Toulon ; Grellier, Paris ; Gueissaz, J. A., Paris ; Guichard-

The "Palais des Congrès," built by Napoleon, venue of meetings of commissions.

Perrachon, St. Etienne ; Guillot, G., Paris ; Hedon, E., Perpignan ; Harter, C., Lyons ; Jacquelin, L., Paris ; Jouhaud, Paris ; Kiener, A., Boulogne-sur-Mer ; Kofyan, Eymoutiers ; Kleber Colombes, Paris ; Lacrouts, Paris ; Laffont, J. J., Paris ; Lambert, Arles ; Lanoe, Marseilles ; Larbouillat, J., Antony ; Laridan, J., Paris ; Leclere, P., St. Denis ; Legoff, Lyons ; Lelievre, B., Gennevilliers ; Leon, Arles ; Maire, M., St. Denis ; Mallet, Paris ; Manschott, Marseilles ; Marfaing, A., Paris; Marin, Tourcoing ; Martin, Nimes ; Marx, E., Marseilles ; Marx, J. Marseilles ; Marzolf, J. J., St. Félix ; Merceron, L., Besse-sur-Issole ; Moutterde, Marseilles ; Navarre, R., Paris ; Neuenschwander, A., Paris ; Omer, Toulon ; O'Connell, Paris ; Papernot, Roubaix ; Pelle, P., Paris ; Pau, J., Paris ; Payan, Arles ; Pouzoulet ; Protard ; Prouhet, J., Nantes ; de Raucourt ; de Redon ; Reignier, Paris ; Remy, D. J., Paris ; Ricard ; Rognon, G., Herblay ; Roussel, L., Macon ; St. Girons, G., Paris ; Salles, Ch., Paris; Sauvaire, Marseilles ; Simon ; Sordoillet, R., Avignon ; Souzy, Marseilles ; Strady, Paris ; Tardivon, B., Paris ; Tauvel, Asnieres ; Tinard, H., Paris ; Thevenot, R., Paris ; Thion, Marseilles ; Tirel, J., Paris ; Tortel, Arles ; Tramond ; Ulrich, R., Meudon-Bellevue, Useo, Paris ; Vahe, Avignon ; Vedrenne, J., St. Denis ; Verlot, J. B., Paris ; Veyre, Paris ; Vidal, P., Lyons ; Vigna, Lyons ; Wallach, Lyons ; Wanner, (Sté), Marseilles ; Wanner, Marseilles.

French W. Africa : David, M., Abidjan ; Domwahi, Abidjan.

East Germany : Adomeit, H., Berlin ; Müller, G., Zwickau ; Schulze, J., (Melle), Magdeburg ; Schultz, W., Berlin ; Wartemann, W., Magdeburg.

West Germany : Kuprianoff, J., Karlsruhe ; Lang, O., Stuttgart ; Linge, K., Karlsruhe ; Löwer, H., Karlsruhe ; Niemann, H., Hamburg ; Paul, H., Nuremburg ; Schmidt, Th. E., Mannheim ; Schutzsack, U., Karlsruhe.

Great Britain : Banks, A., Aberdeen ; Barnard, A. J., Dartford ; Bird, G. L.H., London ; Douglas, W. S., London; Fischer, H. W., London ; Gosney, W. B., London ; Heap, E. M., London ; Heckmatt, H. H., Chester ; Jennings, G. E., London ; Michael, W. R., London ; Sinclair, W. R., London ; Spencer, R., Hull ; Steward, R. H., London ; Tomkins, R. G., Larkfield ; Trace, L. H., London ; Raymond, T. A., London.

Hungary : Robert, P., Budapest.

Israel : Landsberg, R., Haifa ; Schenirer, Tel-Aviv.

Italy : Altieri, M., Rome ; Bottini, E., Turin ; Isetta, P., Trieste ; Luzzato, B., Rome ; Mattarolo, L., Padua ; Osti, O., Milan ; Perticara, G., Padua ; Rasi, A., Padua ; Salvo, O., Milan ; Stradelli, A., Turin ; Valazzi, L., Rome.

Morocco : Fritz, Marrakesch.

Norway : Lorentzen, G., Trondheim.

Netherlands : Grenier, Bois-le-Duc ; Jerne, T., Rotterdam ; Koot, W. J., Rotterdam ; Vahl, L., Delft.

Poland : Czaplinski, S., Cracow ; Kaminski, Cracow ; Latkowski, J., Cracow ; Merc, L., Warsaw.

Spain : Arryo Vighi, F., Madrid ; de la Camara Cumella, F., Madrid ; Guttierrez del Arroyo, M., Madrid ; Lobato, Munoz, Madrid ; Munoz-Delgado, J. A., Madrid ; Martinez de la Madrid, A., Madrid ; Moller, E., Barcelona ; Puig, Pena, Saragossa ; Martin-Serrano, J., Madrid.

Switzerland : Baumgartner, E., Basle; Goldmann, P., Zürich ; Jakob, A., St. Margrethen ; Kubli, H., Zürich ; Meyre, W., Winterthur ; Pieffort, Basle; Roethlisberger, B., Thielle - Wavre ; Somm, H., Rorsbach ; Wegmann, H., Zürich.

Tunisia : Cohen, Tunis.

U.S.A. : Chamberlain, J. R., York ; Hardenburg, R. E., Beltsville ; Kayan, C. F., New York ; Simons, Ed., San Francisco.

U.S.S.R. : Klimenko, Mme., Moscow ; Lavrov, Moscow ; Martynovsky, V., Paris ; Rutov, D., Moscow ; Tkatchev, N., Moscow.

In addition, there were about 15 late registrations.

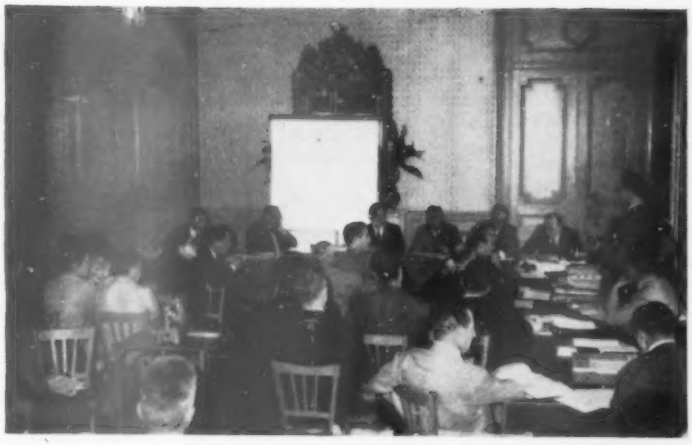
Extracts from a selection of the papers presented in the three commissions

COMMISSION 3

The New Era in Absorption Refrigeration

By L. H. LEONARD,
Carrier Corporation, New York, U.S.A.

The oldest known device to generate cooling has made a spectacular comback during the past decade. Starting with the discovery of its basic principles by Nairn as early as 1777, absorption refrigeration was commercially important up to the early years of the 20th century. For nearly three quarters of a century, it was the only type of refrigerating machine widely available in medium and large capacities. However, these machines were huge and unwieldy, with high owning and operating costs. The development of more practical mechanical refrigerating equipment with electric motor, steam engine or turbine driven compressors quickly put an end to their use. But, while compression refrigerating machines have many advantages, they failed to satisfy the need for a machine that could use low pressure steam directly without a prime mover. The introduction in 1945 of the first large capacity, steam operated, lithium-bromide-water absorption machine for commercial use opened a new era for this cooling cycle. In less than 10 years, a complete line of heat operated absorption machines was available in nominal capacities ranging from 60 to 700 tons. Today, this line ranges from 50 to 1,000 tons and well over 1,500 machines have been sold to date. Examination of the elementary cycle will aid in understanding its efficiency and simplicity. Fig 1 (p. 1044) shows the basic cycle which consists of an absorber, generator, condenser and evaporator. The heat exchanger, while not necessary for operation, greatly improves thermal efficiency. The absorption cycle is based on a physical phenomenon whereby one substance, called the absorbent, and having a sufficiently low vapour pressure, will absorb vapour liberated from a boiling refrigerant. By maintaining the proper absorbent conditions, in this case the concentration and temperature of the lithium bromide water solution, the absorbent will continuously withdraw refrigerant vapour, causing more to evaporate and thus creating a cooling effect. In figure 1, the lithium bromide solution is sprayed over the condensing water coil in the absorber (1). The coil maintains the desired solution temperature and removes the heat released by condensation of the refrigerant as it enters the solution. The solution being continuously diluted by



Commission III in session at Marseilles.

Commission IV dealing with biological aspects of refrigeration.

Commission V, with M. J. Foulon, Brussels, front right, and behind him Mr. G. E. Jennings and Mr. W. R. Michael from London.

refrigerant is delivered by the pump (2) through the heat exchanger (6) to the generator (3), where the refrigerant is boiled out by steam (or any other source of heat). The reconcentrated solution returns through the heat exchanger (6) to the absorber to continue the solution cycle. Water vapour from the generator (3) passes to the condenser (4) where it is condensed and returned to the evaporator (5). Here the refrigerant evaporates, cooling the brine or other fluid as desired. The vapour passes to the absorber (1), completing the cycle. The most recent development in controls in the United States is the solution by-pass system which incorporates several marked advantages. Valve operation is regulated by the leaving chilled water temperature. Only the solution required is sent to the generator ; thus, preheating of the solution at partial load does not become a greater portion of the total generator load. This results in a constantly decreasing steam rate, giving the highest partial load efficiency of any of the

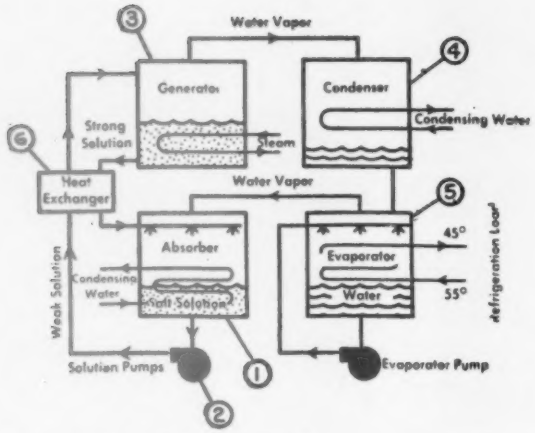


Fig. 1.

systems and capacity is controllable down to zero load. The machine is not restricted to the cooling of liquids ; in recent applications it has served as an intercooler for high pressure air. Multiple installations present no problems. A notable example is the Idlewild International Airport Terminal Building. Nine 700-ton machines are installed in parallel which makes an impressive installation using high temperature hot water as the energy source.

Methane cycle with isenthalpic and isentropic expansions for low temperature refrigeration.

By Cl. CHARCOSSET
ENSM, Nantes, France

This paper draws attention to a methane cycle the efficiency of which is higher than isothermal compression —isentropic expansion cycle The characteristics of the cycle are : 1. Compression at a pressure above critical (45·5 kg/cm²) and limited to 70 kg/cm² in order to minimize isenthalpic expansion losses. 2. Two-stage cooling of compressed gas ; the first exchanger lowers temperature to approximately –40° C., the second exchanger to about –125° C. Two exchangers are used in order to limit irreversible losses due to temperature differences. Cooling of the compressed gas is ensured by counter flow : (*a*) by methane from the evaporator, this gas passing through both exchangers. (*b*) by methane isentropically expanded from high pressure to intermediate pressure, this gas only passing through the first exchanger. (*c*) by methane isentropically expanded from high to low pressure. This is a two-stage expansion, the gas passing twice through the second exchanger. Such a cycle for methane evaporation at 1 kg/cm², *i.e.* –161·5° C., shows an efficiency of 49 per cent. (This efficiency is the ratio of the cycle coefficient of performance to that of the Carnot cycle in the same temperature range.) For example, it will be noted that the efficiency of the " isothermal compression isentropic expansion " cycle, with the same temperature range, the same temperature differences, the same compressor and turbine efficiencies, is approximately 38 per cent. Under these conditions, the Philips cycle gives an efficiency of 41 per cent.

Centrifugal compressor of simplified construction, gyroscopic effect and balance.

By M. BEDUE, et M. MAIRE,
Chantiers de l'Atlantique, France

The construction of centrifugal compressors with two overhung impellers does not present any difficulty for fluid circulation. It is interesting to know, from the dynamic point of view, how the assembly runs, specially with gyroscopic effect. At normal running speed, under centrifugal force, the shaft is bent progressively, and impellers are differently inclined on the axes. Tangents perpendicular on transversal planes passing through centre of gravity of impellers are, for each one, the generatrix of a cone of rotation, inclination of which on the axis is given by two different angles. Proportionally to these angles, there is a positive motion of precession. The intensity of this motion, different for each impeller, can submit the shaft to a sinusoidal movement of flexion corresponding to a given pulsation. The maximum intensity of this outside oscillation can involve mechanical irregularities as vibrations or even breakage of the shaft between impellers. Consequently, the authors have been led to make impellers solid so as the rotating assembly is made a single unit, practically indeformable. Then, we have no more than a single precession which is synchronous and positive, impeding the shaft bending and increasing the critical velocity of the rotor. In the case of turbo-blowers, the addition of the turbine wheel on the other end of the shaft involves another phenomenon of precession similar to the first one. It must be noted that the central part of the shaft between the bearings has to impede the superposition of these two gyroscopic forces and the inertia has to be great enough to consider the overhung parts as fixed ones and therefore independant of each other.

Capacity control of reciprocating compressors.

By J. VEDRENNE,
Chantiers de l'Atlantique, France

Many devices used for the capacity reduction of reciprocating compressors use a mechanism which lifts the suction valves of the cylinder so that no compression is obtained ; the refrigerant vapour enters and is then discharged through the suction port. The device proposed will eliminate completely the filling of the cylinder by stopping the flow of gas before the suction valve. The method of closing the gas inlet depends upon the valve design and will not be described in this summary. The advantages deriving from this device are :—The suction valves are not in contact with lift pins which can stress and break them ; the pressure loss and wiredrawing effects through the suction valve ports are eliminated with a subsequent saving in power ; the device is simple and is not subjected to pulsations arising from the piston motion.

Utilizing New Refrigerants to Obtain –120° C. in Cascadeless Refrigerating Machines.

By I. S. BADYLKES
Scientific Research Institute of the Refrigerating Industry of the U.S.S.R. Moscow, U.S.S.R.

A normal, single refrigerant is inadequate for obtaining very low temperatures in vapour compression machines and it becomes necessary to utilize cascade circuits with two or even three refrigerants. Such circuits are very complex, especially in the case of small plants designed for various field and research purposes. The author drew the attention in 1956 to the possibility of obtaining low evaporating temperatures down to –100° C. by means of only one refrigerant, namely : CHF_2Cl. (1). A vapour-jet device is used in this case in the lower stage due to which the pressure in the evaporator (0·0205 ata) increases up to 0·128 ata. A further rise of the pressure up to 12·27 ata (+30° C.) is performed by a two-stage compressor. This cycle may be performed for lower temperatures with the selection of a corresponding refrigerant. It follows from the previous works of the author (2) that the pressure and volumetric refrigerating capacity *qv* kcal/cu.m lawfully increase at similar temperatures at a drop of the refrigerant normal

1. Members and wives aboard the luxury liner "Jean Mermoz."

2. Aboard the launch cruising through dockland; Eng. Commander W. R. Sinclair and Mr. W. S. Douglas can be seen in the foreground.

3. Snapped in the Jardin du Pharo: l. to r. Joint editors of the Copenhagen Congress proceedings, Mr. and Mrs. Mogens Jul; Mr. N. H. Hansen and Dr. A. Banks, Aberdeen.

4. Mostly British delegates are here to be seen, including Col. H. Randal Steward and Mr. W. S. Douglas, left back; Mr. W. B. Gosney and Dr. A. J. Barnard, Dartford, facing camera.

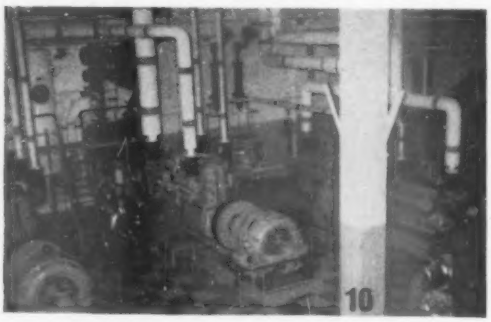
5. Another view aboard the "Jean Mermoz."

6. As the launch approached this lift-and-swing bridge a lorry tried to be last across but reversed off just in time to avoid the high dive. The hosts explained that this event was not put on for the amusement of visitors.

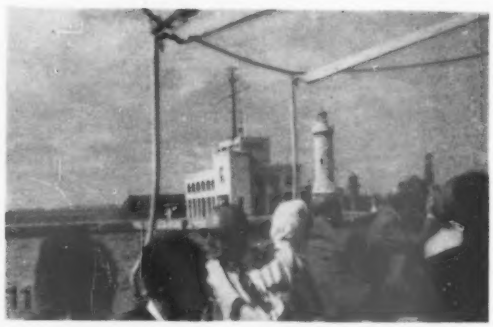
7. A fine variety of refrigerated transport lined up for inspection at the Glacières de Paris ice plant in Marseilles.

8. True French ingenuity is shown here in the design of a "mobile ice hopper" for charging the bunkers of refrigerated railway vans.

9. The delegates descend on the Marseilles ice plant.



10. Engine room, beautifully laid out and as clean as a new pin, at Glacières de Paris.



11. Passing the harbour entrance at Marseilles.

12. The luxury liner "Jean Mermoz" used on the West African service.

boiling temperature *tb* (at 1 phys. atm). Thus, with the accepted minimum suction pressure of 0·1 ata in reciprocating compressors, it became possible to obtain the lowest evaporation temperatures by means of vapour-jet devices only due to refrigerants with low *tb* values. However, when rejecting cascade circuits, the refrigerant condensation pressure should be considerably below the critical. The possibility of operating standard compressors is provided in this case and energy losses are eliminated due to the fact that the process takes place far from the critical temperature.

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JOINT MEETING
COMMISSIONS 3 and 5

Method of Determining Characteristics of a Lithium Bromide Absorption Refrigerating Machine.

By L. M. ROSENFELD and M. S. KARNAUKH,
Leningrad Technological Institute of the Refrigerating Industry, Leningrad U.S.S.R.

This paper is devoted to relating the method of determining the refrigerating capacity and evaporating temperature in the lithium bromide absorption refrigerating machine evaporator under any given parameters of external sources. This method can be applied also with water-ammonia absorption machines.

Improving some types of evaporators in a multi-temperature warehouse.

By L. ROUSSEL and P. VIDAL
Entrepôts Frigorifiques Lyonnais—Lyon (France)

Remarks about working, since 1954, of evaporators in the E.F.L. Chalon-sur-Saône warehouse plant with direct expansion of ammonia.

I.—*Circuit of rooms at 0 °C.* :
- Remarks about accidents due to :
  1. leaks in solenoid valves on liquid line and in back-pressure valves.
  2. excessive frosting on evaporators.
- Precautions against dangers of freezing defrost water supply and drain lines.
- Advisability of divided evaporators with electric heaters.
- Necessity for protection of oil pots and level indicators.

II.—*Circuit of rooms at –20 °C.*
- Remarks about leaks of liquid due to external pressure equalising lines thermostatic expansion valves and about over-charge of evaporators.

III.—*Heat-Pump evaporator* :
- Accidents due to ferruginous bacteria ; treatment with chlorine.
- Necessity to place liquid traps between evaporators and compressors.

Design and operation of cooling units in large cold stores.

By J. LARIDAN,
Société Francaise de Transports et Entrepôts Frigorifiques, Paris (France)

A large 25,000 m³ cold store at present under construction in the neighbourhood of Paris will provide either for the quick-chilling of fresh products and their storage at temperatures above O °C. (32° F) or the storage of frozen foods at –25° C. (–13° F.) The cooling units, ammonia direct expansion, placed in the rooms are composed each of a concrete casing, a finned cooling coil with a surface of 255 m² (2,800 ft.²) and three propeller fans of 10,000 m³/*h* (6,900 cfm). Four cooling units are required for each 2,200 m³ room. A defrosting system is provided for low temperature operation at –25° C. The cooling coils are divided into 2 sections (1/3 and 2/3 of the total area) and the fans can be operated together or separately according to the load requirements. The cooling units can be connected to three different circuits with different evaporating temperatures : chilling (–12·5° C.), storage at above O °C. (–7·5° C.), freezing (–35° C.). According to the temperature and the operation selected, the automatic control of the plant is governed by an electronic analogue which will operate the compressors according to the load required.

Evaporators for direct cooling of cold stores.

By A. STRADELLI,
Turin, Italy

A comparison is given of the following types of cooling systems :—
- Evaporators in the rooms with natural convection of the air.
- Evaporators in the rooms with forced air circulation.
- Exterior evaporators and forced air circulation.
- Exterior evaporators and jacket system.

The advantages and drawbacks of each particular system are analysed. In particular, the difficulties arising due to refrigerant leakage into the cold chambers are examined, and possible methods to limit the resulting damages are discussed. As a conclusion, a wish for collaboration at a very early stage of planning between the architect and the refrigeration engineer is expressed.

Combination of absorption and compression refrigeration cycles.

By J. CONAN,
Société Brissonneau-York, Paris-Nantes, France.

The author's purpose is to verify whether the conclusions of TAMM and NESSELMAN are still valid with modern LiBr absorption machines and to investigate the possibilities of their application to low temperatures with a combination in series of both cycles. Viewed from the point of specific energy consumption the combination of the two machines is always advantageous. Viewed from the primary energy consumption such as the fuel consumption of a steam boiler :— (1) The operation in parallel leads approximately to the same specific consumption as the compression cycle ; (2) The operation in series with LiBr absorption units at temperature above –50° to –60° C. leads to a higher consumption ; (3) Below –60° C. the operation in series leads to a lower consumption but higher pressures at the boiler. It must be concluded that the parallel combination can be justified by secondary reasons or when simultaneous use of mechanical energy of heat improves the efficiency of the whole system and that the series connection is probably only advantageous when at the same times as low temperature refrigeration, some heating is to be supplied. This is in contrast to the case when at the same time as rather high temperature refrigeration some mechanical energy is required.

Extracts from papers presented before commissions 4 and 5 will be published in November.

CORRIGENDA

We regret that two errors crept into the September issue due to the incidence of holidays. The first concerned the Miniveil air curtain for refrigerated transport (page 939) ; this was wrongly illustrated with a photograph of the Miniveil "Flystop", reference to which was made on page 940. The Miniveil transport unit will be fully described and illustrated in the November issue.

The second error concerned the letter from Mr. J. C. Townsend of G. Williams Engineering Co. Ltd. In it he stated "last month you published a letter . . ." Mr. Townsend was, in fact, referring to Mr. L. O. Lawrence's (Winget Refrigeration Ltd.) letter in the June issue of "M.R." and *not* to Mr. A. Jones's (Warrington Tube) correspondence in August.

Temperature Measurement of Frozen Fish

By J. GRAHAM

Torry Research Station, Aberdeen, Department of Scientific and Industrial Research.

A simple and accurate method of measuring the temperature of randomly selected blocks of fish for use as a check on both the freezing process and on the refrigerating arrangements during storage and transport of the frozen product has been a long-felt want in the industry. One method widely used at present involves boring a hole in the frozen fish and inserting a conventional type of glass thermometer contained in a tubular metal holder. The accuracy of this method was suspect and the purpose of the series of tests described below was to establish what degree of accuracy could be counted upon in practice. It was felt that thermocouples or a new probe type resistance thermometer[1] might be more suitable and these were also tested to determine their accuracy under specified conditions.

THE use of glass thermometers to measure the temperature of frozen fish is a particularly inaccurate and inconsistent method even under the most favourable conditions. Under adverse conditions often obtaining in industry the error in assessing the storage temperature of a block of fish whose true storage temperature was minus 20° F. can be as much as 36°F.

Precise measurements of the temperature of frozen fish can be made by means of a thermocouple previously frozen into the block but for a number of reasons this method would be unsuitable for general use in the industry. (This particular technique was adopted throughout the series of tests as a check on the accuracy of the other methods.)

For taking spot checks of temperatures two other methods investigated proved much more satisfactory than glass thermometers. The insertion of a thermocouple or probe type resistance thermometer into a hole bored in the frozen block will give consistently accurate results, but for simplicity, robustness, and the degree of response desirable in an industrial instrument the probe type resistance thermometer is preferable.

Methods

The conditions prescribed for the tests were :—

1. The blocks of fish used in the tests were taken from a closely controlled low temperature chamber with a nominal temperature of minus 20° F. and in which the actual temperature during the period of the test was between minus 19°F. and minus 20·5° F.

2. The blocks of fish used had been quick frozen down to storage temperature and held in storage for a number of weeks before the commencement of the tests. In none of the tests was the fish removed from cold storage for a period greater than 20 minutes before being returned to storage where they were maintained for 24 hours before being used in a succeeding test.

3. The true temperature of the frozen block of fish was determined by a thermocouple which had been previously frozen into the centre of the block with at least 4 in. of its length from the point of measurement in a plane parallel with the major surfaces of the block (fig. 1).

4. Holes bored in the block of fish to accommodate the various temperature measuring devices were drilled along the mid plane of the block with the temperature-sensitive part of the device located at a point immediately adjacent to the check thermocouple (fig. 1).

5. The holes in the block of fish were bored with conventional type twist drills although in some cases special extra long drills were used to obtain the necessary depth.

6. In the tests where the hole was bored before removal from the cold store this was done at least 24 hours previous to the test.

7. Zero time for each test was the amount the frozen fish was removed from the cold store. (In industry the temperature check takes place not in the cold store but after removal from the cold store).

8. In practice it was 1½ to 3½ minutes after the removal of the frozen block of fish from storage before any temperature readings were taken, the time interval being generally longer where the hole had to be bored after removal from the store.

9. The temperature measuring

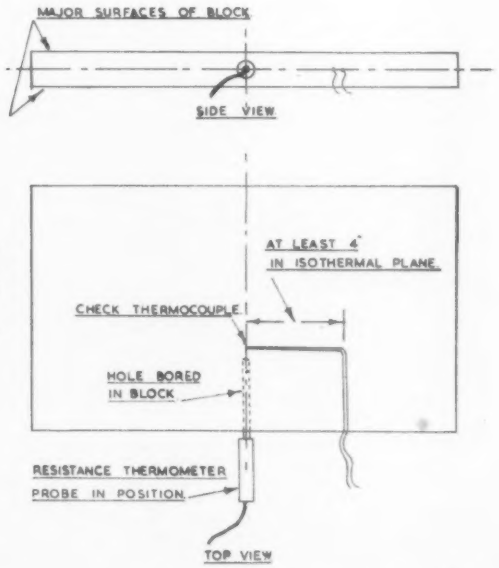


Fig. 1.—Location of temperature-measuring instrument in block.

instruments used in the tests were as follows :—

(*a*) The mercury-in-glass thermometer had a temperature scale of −35° F. to 100° F. in 0·5° F. divisions with an accuracy of ± 0·25° F. (*b*) The instrument used to take the thermocouple readings was a direct reading electronic precision indicator with an accuracy of ± 0·25° F. (*c*) The instrument used with the resistance thermometer probe was a compact bridge arrangement with a null deflecting galvanometer, the temperature scale range was −30° F. to +70° F. in 1° F. division with an accuracy of ± 0·25° F.

10. The ambient temperature outside the store was 65° to 75° F.

Results

Both thermocouples and resistance thermometers can be so constructed as to have the temperature sensitive element protected by a tubular metal probe and it has been found by experience that these probes will penetrate frozen white fish without the necessity of boring a hole only if the temperature of the block is higher than plus 26° F.

For the size of blocks used in these experiments the accuracy of the method was affected only slightly whether the hole was bored in the block for the insertion of the temperature sensitive element 24 hours before removal, or after removal from the store immediately previous to making the temperature measurement. As would be expected, the time lag between removal from the store and measurement of the temperature will be generally longer when the hole has to be bored after removal from the store but this might be partly compensated by a quicker response of the temperature sensitive element by insertion in an initially "wet" hole.

TABLE I

MERCURY-IN-GLASS THERMOMETER

Cold storage temperature minus 20° F. Ambient temperature 65° to 75° F.		
Test	Conditions	Nearest approach to Initial storage temperature
Effect of depth and diameter of hole ; bored after removal from storage	1½ in. deep, neat fit	17·4° F. after 8 mins.
	3¼ in. deep, neat fit	10·1° F. after 7 mins.
	1½ in deep, loose fit	35·1° F. after 13 mins.
Effect of boring hole before or after removal from storage	3¼ in. deep hole neat fit — Bored before	6·2° F. after 7 mins.
	3¼ in. deep hole neat fit — Bored after	10·1° F. after 7 mins.
Effect of block dimensions. 3¼ in. deep hole, neat fit, bored after removal from storage	Cod fillets, 2 in. thick, weight 8 lb.	12·5° F. after 7 mins.
	Whole cod, 4 in. thick, weight 56 lb.	10·1° F. after 7 mins.
Effect of various types of thermometer holders. 3¼ in. deep hole, neat fit, bored after removal from storage	1. 6¾ in. long square end.	10·1° F. after 7 mins.
	2. 13 in. long square end.	9·8° F. after 11 mins.
	3. 7½ in. long spear type end.	12·0° F. after 10 mins.

Results of the various tests are given in Tables I, II and III.

Discussion of Results

Mercury-in-Glass Thermometers.— Under the most favourable conditions *i.e.* with a hole bored in a large block of fish of suitable depth and diameter previous to removal from the cold store the error in measuring the true storage temperature of the block may still be as much as 6° F. with a temperature difference between the store and the space where the temperature check is made of 90° F. The time of nearest approach to storage temperature may vary from 7 mins. to 13 mins. after taking the block out. More accurate results with a quicker response may be obtained if the thermometer is used without the tubular metal guard but because of the danger of breakage this practice is not recommended. A number of variables have an influence on the ultimate accuracy of the method and if two or more of these are unfavourable then the error in measuring the true storage temperature of the block in the conditions described may be as much as 36° F.

Thermocouples. — Thermocouples frozen into the block under specified conditions give precise readings of the block temperature. Because of the necessity to freeze the thermocouples into the block and the inability to remove them until the block of fish is thawed this method would be undesirable for general use in industry but as a means of keeping a continuous record of temperature during freezing, storage, transport and thawing, in test cases, this method is ideal.

Thermocouples inserted into holes bored in the block give satisfactory results with an error of 3·5° F. when measuring a block at an initial storage temperature of minus 20° F. in an ambient of 70° F. The time from removal of the block from storage to this nearest approach was 6 mins. The greater part of the temperature error was due to the time lag and the consequent warming up of the block. The thermocouples used in these tests were insulated by inner and outer sheaths of synthetic rubber with only the temperature sensitive junction bare. This is the probable reason for the comparatively slow response of this method compared with the probe type resistance thermometer. For

TABLE II

THERMOCOUPLE

Test	Conditions	Nearest approach to Initial storage Temperature
Effect of boring hole before and after removal from storage 3¼ in. deep hole, neat fit	Bored before removal from store	3·6° F. after 6 mins.
	Bored after removal from store	3·4° F. after 6 mins.

TABLE III

RESISTANCE THERMOMETER PROBE

Test	Conditions	Nearest approach to Initial storage temperature
Effect of depth of hole, hole bored before removal from storage	3 in. deep hole, neat fit	3·0° F. after 4 mins.
	4 in. deep hole, neat fit	1·2° F. after 7 mins.
	5 in. deep hole, neat fit	0·9° F. after 5 mins.
Effect of boring hole before and after removal from storage 4 in. deep hole, neat fit.	Before removal from store	1·2° F. after 7 mins.
	After removal from store	2·8° F. after 7 mins.
Effect of diameter of hole. 4 in. deep bored after removal from store	Neat fit	2·8° F. after 7 mins.
	Loose fit	4·8° F. after 6 mins.

this particular purpose thermocouples could be constructed with the wires suitably insulated and threaded through a tubular metal probe, the response and accuracy would then be comparable with a probe type resistance thermometer.

Resistance Thermometer Probe.—This instrument gave particularly accurate results under ideal conditions, the error being less than 1° F. with a temperature difference between storage temperature and ambient air of 90° F. The error is entirely due to the time lag involved and the consequent warming of the block of fish.

Conclusions

Even for measuring the actual temperature of a block of fish at any given moment glass thermometers used under very stringent control cannot be relied upon to give a good indication of the temperature. With any degree of tolerance on the ideal specified conditions the temperature indicated can be completely false. Thermocouples and a probe type resistance thermometer can both give accurate results.

Errors can arise from conduction of heat along the instrument or its sheath and also from poor contact between the sensitive element and the frozen fish. These errors are difficult to avoid with glass thermometers. Both thermocouples and resistance thermometers lend themselves to suitable construction which is sufficiently robust for industrial use and at the same time the care required to achieve sufficient contact at a suitable depth in the block is of a degree more suited to industrial use than in the case of glass thermometers. With suitable construction of element and sheath and a suitable depth of penetration conduction of heat along the probe has no practical effect on the temperature indicated and both thermocouples and probe type resistance thermometers can be used on blocks of frozen fish inside as well as outside the cold store provided the measuring and indicating components of the instrument are suitable.

Where the practice is to measure the temperature of a frozen block after removal from store or transport, in an attempt to deduce what the storage or transport temperature was, there will always be an error due to the block warming up between the time of removal and the time of taking the measurement. The slower the response of the temperature sensitive element of the measuring instrument the greater this error will be. Glass thermometers which are a loose fit in the hole bored in the block are quite useless. Fast-response instruments such as thermocouples and probe type resistance thermometers of suitable construction can indicate the actual temperature of the block within seconds and thus can give a very fair idea of the storage temperature provided there is no delay between removal from store and making the temperature measurement. In practice the nearest approach after removing a block from a minus 20° F. cold store to an ambient air temperature of 70° F. can be as small as 1° F.

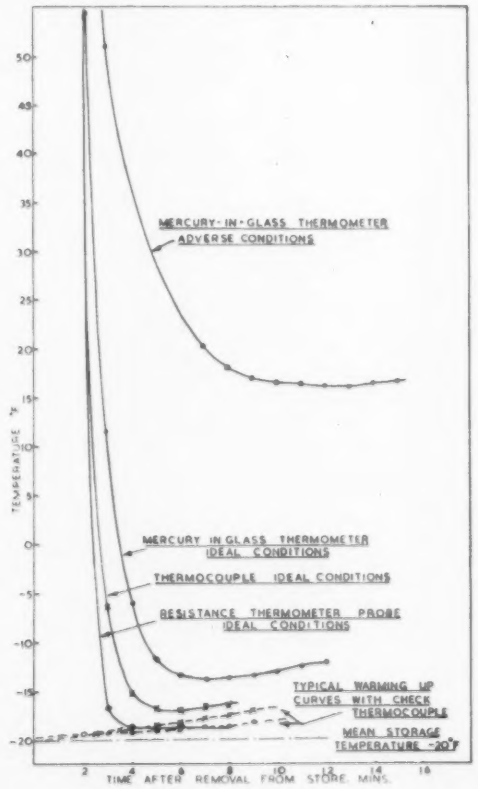

MERCURY-IN-GLASS THERMOMETER ADVERSE CONDITIONS
MERCURY IN GLASS THERMOMETER IDEAL CONDITIONS
THERMOCOUPLE IDEAL CONDITIONS
RESISTANCE THERMOMETER PROBE IDEAL CONDITIONS
TYPICAL WARMING UP CURVES WITH CHECK THERMOCOUPLE
MEAN STORAGE TEMPERATURE -20°F
TEMPERATURE °F
TIME AFTER REMOVAL FROM STORE MINS.

Fig. 2.—Typical temperature curves for 4-in. thick block whole cod at initial storage temperature of −20 F.

It is of course necessary to observe the temperature indicator closely for several minutes in order to ensure that the nearest approach has in fact been determined. (See Fig. 2.)

REFERENCE

[1] JASON, A. C., & LEES, A. (1959). "Resistance Thermometer Spear for Field Measurement," *Journal of Scientific Instruments*, Vol. 36, June.

GERMAN REFRIGERATION CONFERENCE

THE German Refrigeration Association (DKV) held their 1960 conference in Frankfurt-on-Main from October 13 to 15, after an informal gathering on the evening of Wednesday, October 12.

The presidential address was by Prof. Dr.-Ing. W. Fuchs of Aachen, the subject being "Controlled thermal core fusion."

At the Thursday afternoon session of section I, the chairman was Dr. H. Linde of Munich, and the following papers were presented :

1. Prof. Dr. F. X. Eder, Berlin.
   The thermal conductivity of sintermetals at low temperatures.
2. Dr. H. Steinle, Stuttgart.
   The surface tension of refrigerants, refrigeration oils and their mixtures.
3. Dr. S. Poganski, Frankfurt-on Main.
   Results of experimental research in maximum temperature difference, cooling load, and performance coefficient of Peltier elements.
4. Dipl. Ing. H. Löwer, Karlsruhe.
   Thermodynamic data on lithium-bromide water mixtures.
5. Prof. Dr. Ing. W. Niebergall, Berlin.
   "Freon" as refrigerant for absorption refrigeration.

Section II, whose chairman was Prof. Dr.-Ing. Th. E. Schmidt of Mannheim, met on the morning of October 14, for the following papers :

1. Dr. H. L. von Cube, Frankfurt.
   New lines of development in construction of refrigerator cabinets.
2. Dr. H. Schmidt, Bad Homburg.
   Selection of capillary tubes as throttle for refrigerators.
3. Dipl. Ing. H. G. Hirschberg, Karlsruhe.
   Performance measurements of small refrigeration machines.
4. Prof. Dr. Ing. V. Füner, Karlsruhe.
   Electronic indicators for hermetic compressors.

Section III, whose chairman was Dr. Ing. H. U. Thormann of Hamburg, heard the following papers :

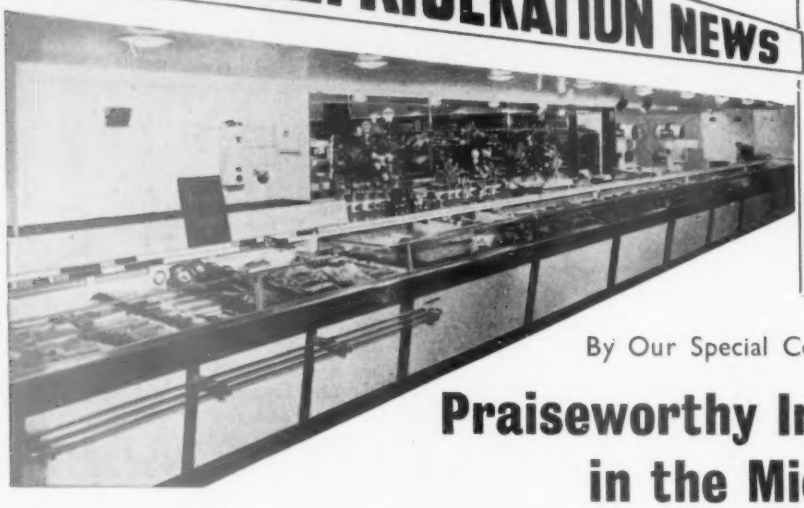
1. Dipl. Ing. J. Gutschmidt, Karlsruhe.
   Freezing of fish.
2. Dipl. Ing. K-F Leopold, Hamburg.
   Cooling and crystallizing plastic masses in the chemical and food industries.
3. R. auf dem Hövel, Leichlingen.
   Development of deep cooling methods in science and industry.

Visits were organized to Hoechst A. G. Paint Works, to the Municipal Slaughterhouse at Frankfurt, to the Stempel-Hermetik Gmbh, Offenbach, to Hartmann & Brown A. G., to the Batelle-Institute, to Honeywell Gmbh, to Roemerkastell Saalburg, Bad Homburg, J. G. Mouson & Co., to the Senckenberg Nature Museum, to Goethe House, Palm Garden, and to the Roman Emperor Hall.

Refrigeration at Olympics

Cold Drinks at "The Games"—Organizing the distribution and sale of iced Coca-Cola to cope with the influx of some 7,000 athletes and hundreds of officials from 85 countries; together with many additional thousands of visitors at the peak of a hot summer in Rome, was the problem facing the local bottler of Coca-Cola—Azienda Romana Imbottigliamento Bevando—during this year's XVII Olympic Games. Some measure of his tremendous success could be judged by the fact that Coca-Cola appeared to be available almost everywhere in Rome refreshingly "within arm's reach of desire." To meet the demand, 16 red Majestic open-type electric coolers were placed in each of the Olympic Village's 10 restaurants and both "Coke" and Fanta were supplied free to the athletes for consumption with their meals. During the games, Coca-Cola was sold to spectators at 175 stadium outlets and in the stadiums themselves some 700 vending boys equipped with ball-park carriers refreshed spectators as they watched events in some of Rome's hottest weather. There were other outlets in the shopping centre and elsewhere.

SHOP REFRIGERATION NEWS



Self-Service in Excelcis

By Our Special Correspondent

Praiseworthy Installations in the Midlands

SINCE celebrating the grouse season last month, I have visited what I thought at the time, and still do think, is one of the pleasantest and most conveniently laid out self-service food departments in this country. And, so far as refrigeration is concerned, it certainly has one of the most interesting and impressive installations I, with a very wide experience of self-service-stores, have ever seen.

Indeed, having this month an unusually good collection of outstandingly interesting examples, I now turn from grouses to songs of praise. It so happens that they are all from the Black Country and its environs. But since I live south of London myself, there is no risk that the inference will be drawn that, in presenting the shops of this part of the Midland counties as models of refrigeration progress, I am influenced by local loyalty.

The self-service department to which I have just referred is on the lower ground floor in Beatties store at Wolverhampton. It contains no excrescences or dumps of tumble-displays or shopper-stoppers or customer-trippers. Moreover, contrary to the common practice in so many of the supermarkets, it does not chop and change about. Unless there is a very good reason for altering the position of any class of merchandise, it always remains in the same place. And every classified section, including those in the 32-ft.-long run of double-tiered refrigerated displays is clearly signposted.

This department is an exemplar in another respect : The refrigerated equipment forms an integrated part of the interior design. The continuous line of cabinets is made—mainly by the inclusion of an illuminated top canopy—to conform in height and certain other characteristics with the wall-fixtures.

From left to right, it comprises : 14 ft. for frozen foods, 12 ft. for dairy produce, and 6 ft. for poultry and ready-wrapped meat. In order to keep the cabinet seen on the right, in the first illustration, in

Fig. 1.—The 32-ft. long double-deck refrigerated display in the self-service food hall of Beattie's store, Wolverhampton.

alignment with the wall and at the same time preserve the unbroken line of refrigeration, it had to be given a mitred join with the end

Fig. 2.—The dual nature of one of the Sutton Coldfield branches of Walter Smith Ltd. is brought out by the shop-front: self-service refrigerated cabinet seen through screen on left; traditional meat display on right.

cabinet in the straight run. I think this must be the longest run of double-deck refrigerated display in the country.

Externally, the cabinets are made in rustless aluminium alloy finished in high-gloss white enamel and framed in stainless steel with clear multi-paned glass front screens at both display levels. Reflecting the display are heated illuminated mirrors set at an angle, and the cabinets are fitted with polythene-covered adjustable shelves.

The refrigerating machinery is housed above and behind the line of cabinets. It is, in fact, compactly installed beneath a pent-roof built for its protection in an open well of the building at first-floor level, where it is well ventilated, completely concealed, and easily accessible.

The cabinets were made and the complete installation carried out by Carter Thermal Engineering Ltd., Bordesley Green, Birmingham, 9.

Another example of this company's work, which, although in complete contrast in both size and character, is also (with one exception) a self-service installation, is one of the Sutton Coldfield branches of Walter Smith Ltd. This small shop (672 sq. ft.) is, in fact, planned to give customers choice of the two methods : ready-wrapped meat to which they can help themselves or the traditional way of having it cut to their requirements. Even the shopfront is designed to demonstrate the two kinds of service provided within. On the right-hand side the typical, if small, butcher's window with hanging rails and display slab. On the left-hand side the equally typical clear view of help-yourself facilities, provided by the screen of plate-glass and the door of toughened glass (Armourplate). Dividing the two are vertical bars of stainless steel.

Fig. 3.—The refrigerated self-service display of ready-wrapped fresh meat in trays, and . . .

Fig. 4.— . . . the alternative choice for the customer—refrigerated serve-over cabinet for unwrapped meat at the back of Walter Smith's shop.

Inside, on the left there is a 14-ft.-long dual-temperature cabinet with a low canopy incorporating a sloping mirror. Beyond, and set at right angles to this cabinet, is a refrigerated counter displaying a selection of cut-up but unwrapped meat. In the right-hand corner there is a small department for cooked meats, delicatessen, and bacon (the only unrefrigerated section of the shop) and between this and the cashier's desk is a 7 ft. 6 in. long glass-fronted

Left: Fig. 5.—From the pavement, shoppers have a clear view of the frozen food cabinets on the left in Chamberlain's shop at Sutton Coldfield.

Below: Fig. 6.—While on the opposite side there is an 8-ft. long refrigerated cabinet for poultry.

Below, bottom: Fig. 7.—Behind Chamberlain's shop the preparation room adjoins the cold-store.

frozen food cabinet. All the refrigerated equipment was made and installed by Carter's.

Two minutes' walk from this delightful shop is one given up solely to fish and poultry and frozen foods. Although not operating on self-service principles it is enclosed by the clear screen of plate glass down to pavement level that we tend to associate with that method.

On the left-hand side are two Prestcold (Farmoor) frozen food cabinets and on the right there is an 8-ft. long Prestcold (Parade) cabinet for poultry. Behind the serving area is a 525 c.ft. Amara coldroom and refrigerating plant comprising a Prestcold A.S. 75 condensing machine and a VCM420 blower-type cooler. The complete installation was carried out by Refrigeration (Birmingham) Ltd.

At Ludlow in Shropshire (still Midlands, I believe, though over 30 miles from the Black Country), there is a unique little food store selling fish, fruit, vegetables, groceries, and frozen foods. Pride of place is given to wet fish all of which is on refrigerated display, and one department (groceries) is on self-service.

The installation comprises a 16-ft. long L-shaped display and service layout, the long leg of the L taking the form of serve-over cabinets while the shorter portion is the window slab. At the rear of the premises there is a 200 c.ft. cold room for fish and poultry and another of 500 c.ft. for fruit and vegetables. The former is operated by a Frigidaire SWF 360 in conjunction with an AD2–50, while for the latter there is an SWF225 fitted with a Frostmaster automatic electric defroster and an AD 1–33 condensing machine. At the back of the shop, there is a low temperature cabinet with a Cooltop refrigerated slab for showing fresh produce above the level of the frozen food display.

The Institute of Refrigeration Bulletin

Institute Headquarters: New Bridge Street House, New Bridge St., London, E.C.4 (CENtral 4694)

The Presidential Address

Engineer-Commander W. R. Sinclair, R.A.N. (ret.), B.ENG., will give his presidential address at the meeting of the Institute to be held in the Memorial Building of the Institute of Marine Engineers, 76, Mark Lane, London, E.C.3, on Thursday, November 3, 1960, at 5.30 p.m. Tea will be served at 5.0 p.m.

SESSIONAL PROGRAMME 1960-61

The following programme has been arranged for the forthcoming session :

November 3, 1960.—The Presidential Address by Engineer-Commander W. R. Sinclair, R.A.N. (ret.), B.ENG.

December 1, 1960.—" Positive displacement rotary compressors as applied to refrigeration " by E. J. Perry, associate member, and P.D. Laing, B.SC.

January 5, 1961.—" The use of two-stage freezing procedures for eviscerated chicken " by R. Gane, M.A., M.SC., PH.D., A.R.I.C. and D. H. Shrimpton, M.A., PH.D.

January 25, 1961.—Annual Dinner at Grosvenor House, Park Lane, London, W.1.

February 2, 1961.—" A new conception in cooling tower design " by Carl Munters and Lennart Lindqvist.

March 2, 1961.—A symposium of papers on " Problems of thermal insulation and their solution " (A joint meeting with the Low Temperature Group of the Physical Society, commencing at 2.0 p.m.).

April 6, 1961.—" Results of practical experiments on relative humidity control " by J. A. Cox, associate.

May 4, 1961.—" Metals for refrigeration and other low temperature installations " by G. P. Smedley, B.ENG., B.MET.

Unless otherwise stated, all the above meetings will be held at The Institute of Marine Engineers, The Memorial Building, 76, Mark Lane, London, E.C.3, at 5.30 p.m. Tea will be served at 5 p.m.

PROCEEDINGS OF THE TENTH INTERNATIONAL CONGRESS OF REFRIGERATION

The " Proceedings of the 10th International Congress of Refrigeration " have recently been completed. They are published under the subsidiary title of " Progress in Refrigeration Science and Technology." This work, which consists of three volumes, is probably the most comprehensive collection of up-to-date material in the field of low temperatures and the application of refrigeration. It covers many aspects of low temperature physics, subjects regarding heat transfer calculations, considerations regarding insulating material, refrigeration machinery and air-conditioning.

A large section is devoted to the use of refrigeration in the food industry, quick-freezing, cold storage warehouses and ice making. Of special interest are the papers on the various methods of small-ice manufacture.

A special section is devoted to industrial and medical applications of refrigeration. The work also covers recent advances in the use of refrigeration in the treatment of diseases and in the medical world as a whole.

The publication also deals with modern problems in transportation of refrigerated food by rail, road, sea and air, and with questions of education and propaganda in the field of refrigeration.

The work comprises papers and discussions at the 10th International Congress of Refrigeration in Copenhagen in August, 1959, held under the auspices of the International Institute of Refrigeration. Thus, it represents a collection of papers and contributions by the world's outstanding experts in its field.

The work is supplied with a complete subject index in order that it may be used as a handbook on refrigeration.

The proceedings consist of the following three volumes :

Volume I : (634 pages of technical material)

Progress in low temperature research and development ; scientific problems of low temperature physics and thermodynamics and industries using low temperature and rare gases ; transfer of heat, thermal properties of materials, instrumentation, insulating materials ; cold and the human being ; applications of refrigeration excluding foodstuffs and agricultural produce.

Volume II : (512 pages of technical material)

Recent developments and trends in refrigerating machinery ; design, construction and operation of machinery and air-conditioning plants ; refrigerated transport of perishable foodstuffs ; refrigerated transport by land and air ; refrigerated transport by water ; education.

Volume III : (483 pages of technical material)

Application of refrigeration to foodstuffs and agricultural produce ; cold stores and ice-making plants ; list of participants in 10th International Congress of Refrigeration ; author index ; subject index.

A special pre-publication price for the work on orders until October 31, 1960, is as follows :

Complete set : £12 10s. Single volume £5.

Price from November 1, 1960 :

Complete set : £20. Single volume : £7 7s.

Post free if cash with order. Orders should be addressed to :—

Pergamon Press Ltd., 4, Fitzroy Square, London, W.1. (or Headington Hill Hall, Oxford). or To The Honorary Secretary, U.K., I.I.R., 131, Great Suffolk Street, London, S.E.1.

Note.—Full members of the congress will receive their copies of the proceedings direct from the congress secretariat.

Temperature Maintenance and Cold Store Construction

"I VERY much doubt if it is widely appreciated that quick-frozen products have a maximum life. The extent of this life depends on the nature and quality of the raw materials, on the processing techniques and the thoroughness with which they are carried out, and on the storage and treatment subsequent to processing." This point was made by Mr. I. M. Rae, cold store and transport manager of Birds Eye Foods Ltd., when he delivered a paper on " Temperature Maintenance and Cold Store Construction " at the N.A.W.D.O.F.F. annual convention at Brighton, on May 17.

It was the general opinion of those best qualified to judge that the best temperature at which to hold the normal run of quick-frozen foods was zero ° F. If any tolerance had got to be accepted on this temperature level during transit or for any other reasons it should not exceed plus or minus 5° F. Quick-frozen products which had a high fat content should be stored at a temperature of –20° F. declared the speaker.

Fluctuations in temperature were to be avoided because they tended to induce accelerations in moisture loss. It was also true to say that holding quick-frozen foods at wrong temperatures noticeably reduced their life, produced a loss of flavour, stimulated the development of off flavours, and lead to deterioration in appearance, vitamin content and nutritional value. The greatest single fact about the consequence of wrong temperature was, however, that any deterioration brought about in this way could not be made good by re-freezing and the sort of deterioration about which he had been talking tended to be cumulative in its effect.

Referring to cold store construction, Mr. Rae said : " Very much has been learned about cold store construction in recent years. I think the most fundamental point to be borne in mind is that before a cold store is completed it should be possible to reach a fairly clear understanding of what is required of it and how it will be worked. In this way a cold store constructor can and should calculate the theoretical heat load which is involved in any particular cold store which he is designing. It is very important that he shonld do so because many aspects of design will have a bearing on this. The most popular insulating medium used in cold store construction was slab cork. In the last year or two, however, many new insulating materials have been introduced and more are being developed."

Referring to vapour sealing, Mr. Rae said that in cold stores there was a tendency for moisture from the outside atmosphere to be attracted through the walls of the store towards the lower temperature inside. At some stage in its passage this moisture would freeze, and when it did so the effectiveness of the insulation would immediately diminish, and the work of the refrigeration machinery increased. Vapour sealing was used to combat this natural tendency. After mentioning some of the methods used, the speaker referred to airlocks and door control, two matters which would justify careful thought and planning.

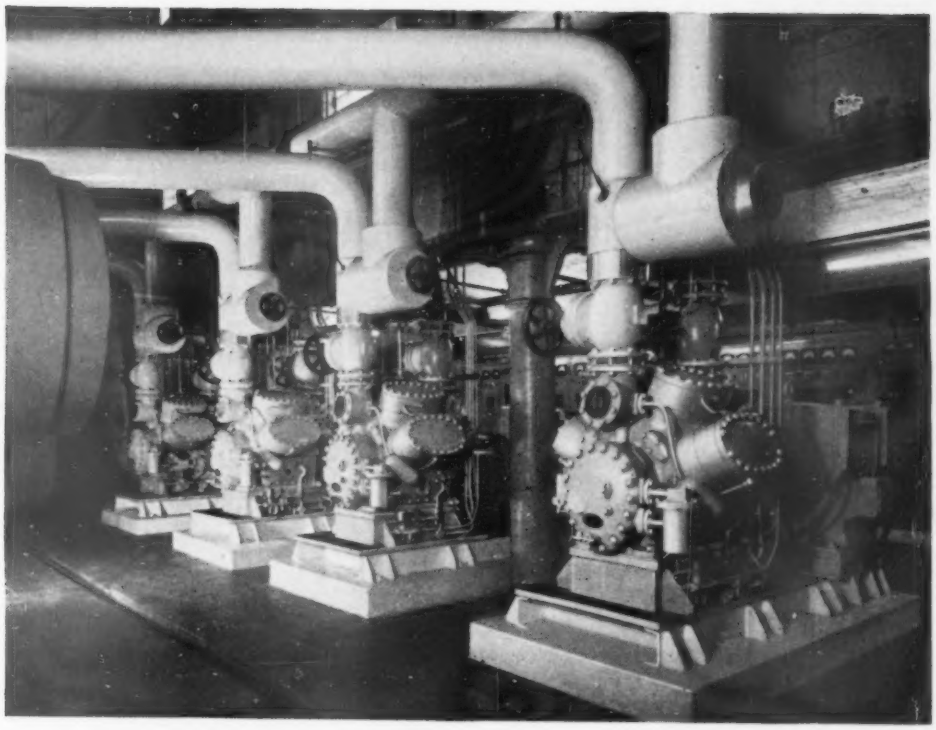
" It used to be considered that the old conception of airlock which was refrigerated was the best solution to the problem of stopping the outside air from getting in, but many improvements in the technique have been made in recent years and the big drawback of the refrigerated airlock is the amount of condensation collected in the form of ice and frost on the hinges and door fittings, etc." A dry airlock was now found more effective, but it had to be vapour sealed.

" There are nowadays a wide variety of refrigeration systems to choose from in equipping a cold store. The old conception of direct expansion coiling fitted to the ceiling of a chamber and/or walls is still quite efficient and economic in some circumstances. There have been many developments in recent years on blast techniques including the self-contained blower unit with automatic defrosting. The layout of a cold store, particularly in the case of air circulating systems, must be such that the circulating air can readily pass round and through stacks so that the refrigeration effect is uniform throughout the chamber. It is possible with a very simple device to test the effectiveness of air movement inside the chamber and it is wise that this should be done periodically. The importance of defrosting and dunnage cannot be over-stressed."

" When designing a cold store it is very wise to draw up two or three plans for possible layouts to meet the operation contemplated and to work out costs both on the construction and operating under these different layouts before deciding which one to adopt. Layout inside a store is very important in achieving an optimum cubic footage to the ton stowage factor."

REFRIGERATION

for
manufacturing
processes



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In brewing, for example, it plays a controlling part in all the processes. The illustration shows the four, 8-cylinder, 5" x 4" veebloc compressors, using ammonia as a refrigerant, supplied to Mann, Crossman & Paulin Ltd., Albion Brewery, London, E.C.1.

J. & E. Hall have supplied refrigerating equipment to all the leading manufacturers in the Brewing Industry.

AP 375

TEST CHAMBER FOR THOR I.R.B.M.

AS mentioned last month, design requirements for the chamber are –35° to +165° F. This span must be provided throughout an outside temperature range of 15° to 105° F. Refrigeration is accomplished by evaporating liquid nitrogen in a coil. Liquid nitrogen is supplied under its own pressure from two cryotanks with capacities of 1,000 gal. and 2,000 gal. respectively.

One tank is tapped while the other is being filled.

Economics favour this method, since the nitrogen is furnished by the base's own cryogenic plant as a by-product of LOX manufacture. After evaporation at about 40 p.s.i.g. the cold nitrogen gas is discharged from the coil to atmosphere.

When the desired chamber temperature is –35° F., nitrogen gas is diverted into the return air duct of the coil. By so superheating this gas from –300° F. to chamber temperature, its capacity is increased about 75 per cent.—a net increase of 33 tons of refrigeration at maximum nitrogen flow of 1,000 g.p.h. The nitrogen is discharged into the return air duct because its coldness and dryness lengthens the defrost cycle time, a critical factor especially at start-up. Diverting this gas into the chamber gradually inerts the interior, necessitating a separate source of breathing air for personnel. This is discussed later.

The capacity of the coil at maximum nitrogen consumption is 50 tons when nitrogen discharge gas is saturated. As mentioned, superheating the gas to chamber temperature yields an additional 33 tons. The relatively low tonnage due to phase change results from the small latent heat of vaporization for liquid nitrogen of 85·8 B.t.u. per lb. Each coil is about 20 sq. ft. in face area. Tubes are seven fins per in., five rows deep. Face velocity is approximately 1,000 c.f.m.

Snow filters originally installed downstream of the coil were removed when experience showed no frost build-up on the fan due to carryover. Farther downstream, however, it is necessary to intermittently energize the electric duct heaters. This removes gradual accumulation of fluff frost. The central fan is run for 10 minutes after the refrigeration is shut down to prevent condensation of liquid oxygen on the coils, since liquid oxygen's liquefaction point is 23° F. higher than that of liquid nitrogen.

Heating of the chamber is accomplished by automatic control of duct heaters on the four supply air levels.

The prime air mover is a single axivane propeller fan powered by a 40 h.p. motor. Approximately 40,000 nominal c.f.m. of air is circulated at standard conditions.

Originally, the fan blade pitch was adjustable semi-automatically to compensate for changing air density during pulldown. Low temperature operating difficulty prompted a change to a manually adjustable pitch fan, permanently set for maximum air flow. Discharge grilles are single deflection, with 1-in. vane spacing to discourage frost build-up by induced air.

Minimizing stratification is a prime consideration in this tall and comparatively narrow enclosure. This is particularly true in a cold chamber where hot air is introduced as part of the load (approximately 2,000 c.f.m. of heated air is blown into the missile). This air exfiltrates into the chamber.

With an average temperature difference during a cold test of 120° F., a chimney of warm air is created which must be offset by rapid air motion and selective air distribution. Chamber air velocity is kept turbulent at from 800 to 1,500 f.p.m. Multi-level supply air dampers are semi-automatically controlled in response to a temperature readout at each level. Reverse stratification occurs in a hot chamber when LOX is pumped aboard the missile.

Where this test chamber is situated in the Mojave Desert, 40 m.p.h. winds with 60 m.p.h. gusts are not unusual. Therefore, up to 650 c.f.m. of outside air is furnished to help neutralize infiltration. To reduce the outside air latent load at low chamber temperatures, this air passes through a commercial, rotating bed, silica gel desiccator and is supplied at about 2 grains. Infiltration due to personnel going in and out of the chamber is minimized through the use of air-lock entrances.

There is no need for outside air when nitrogen gas is injected into the chamber.

Due to the extremely low evaporation temperature of approximately –300° F., defrost is required. This is done by alternating two adjacent coils and their by-pass dampers. Defrost frequency is judged by inspection of a manometer across the coil and viewing the coil face itself through an inspection window. When the air side is pulled down and the latent load is light, both coils operate simultaneously.

In actual operation, there is no crystalline ice deposit but a hard white frost. Defrost is generally begun when 20 per cent. of the coil face is frosted and concluded when defrost air leaving the coil rises to 180° F.

Defrost by-pass dampers are fitted with extruded silicone seals at mating edges. These are adjusted for tightness with a 0·005 in thickness gauge, since even the slightest leakage of –35° F. air would extend defrost immoderately.

Each coil has its own defrost system. This consists of a 5 h.p. blower drawing 2,000 s.c.f.m. of outside air through two 54 Kw. heaters, blowing it at 200° F. through the evaporator coil and thence to the atmosphere. Defrosting requires approximately one-half hour. Obviously, the coil is never to be completely frosted over or defrost would be impossible.

Approximately 2,000 c.f.m. of conditioned air is supplied to the missile to maintain engine and guidance compartment temperatures within prescribed limits. Conditioning is done with two 60 h.p., skid-mounted, air-cooled units. The units are self-contained, including an air compressor for the pneumatic controls. Cycling is done with leaving air thermostats located in the missile inlet ducts.

In order to minimize the outside air latent load, all return air to these units is taken from the central apparatus supply duct. Missile air is never delivered at dew-point temperatures higher than 30° F. Two alternately deftosted 30° F. coils are downstream of a 40° F. pre-cooling coil. Defrost is controlled by a preset

(*Continued on page* 1061)

Our cold vehicles are *VERY* cold

You cold transport operators have many problems. In distribution our expert Marketing Service has been tailored to help you.

We will supply you with a refrigerated vehicle best suited to your particular needs now—or for your future sales programme. Our engineers' designs for refrigerated body and chassis can give you 100% utilisation—this is what you want to make every payload pay.

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timer which actuates by-pass dampers.

The control console consists of the following instruments and readouts :

(1) On-off and maximum supply temperature control for seven three-stage duct heaters at the four supply levels.

(2) Supply temperature recorders

(3) Fan supply and differential pressure controls.

(4) Supply damper control and position indicators

(5) Return damper positioners

(6) On-off control for fan, liquid notrogen supply, and rain simulation nozzles.

(7) Transfer switches to permit control from the blockhouse during countdown

(8) A 24-point temperature pick-up for readouts on the air side.

All dampers and valve actuators on the chamber are pneumatic, utilizing gaseous nitrogen bled from the same bottles used to purge the engine area before engine ignition. Controls are interlocked for automatic operation.

Duration of pulldown and stabilization varies from 6 to 12 hours, depending on desired chamber temperature and outside conditions. Average straight line pulldown rate is about 7°F. per hour. Because of the proximity of rocket fuel and LOX, all switchgear is explosion proof.

COMMERCIAL AND INDUSTRIAL SECTION

Manufacturers' and Distributors' News

Union Carbide Ltd. announces that increased sales by the Chemicals Division of both imports from their associated company in the United States and from their own plant at Hythe, Hampshire, have resulted in the following new appointments in their sales-marketing organization : Product manager, imported chemicals, Mr. R. C. Agabeg ; product manager, manufactured chemicals, Mr. J. C. Marshall ; assistant sales manager, Mr. R. Woollam ; production planning co-ordinator, Mr. R. O. Harvey ; northern district manager (Manchester office), Mr. J. A. Bates. With the exception of Mr. Bates in the Manchester office the other gentlemen mentioned are located at the new offices of Union Carbide at 8, Grafton Street, London, W.1. The telephone number, MAYfair 8100, remains unchanged.

* * *

Mr. K. G. Sinclair, chairman of the Griffin & George Group of Companies, Alperton, Middlesex, last month officially opened the new Scottish warehouse sales and servicing centre and offices, at Braeview Place, Nerston, East Kilbride, Scotland. The new headquarters for Scotland is another step in the programmed expansion and development of the firm founded 134 years ago 10 miles away from Braeview Place, in Buchanan Street, Glasgow, by John Joseph Griffin. To-day the Griffin & George Group is the largest supplier and manufacturer of laboratory equipment in Europe for the universities, technical colleges, schools and other educational establishments and research and development institutions and industrial laboratories all over the world. The 14,000 sq. ft. of new premises will unite the two former Scottish centres at Johnston Terrace, Edinburgh, and at Renfrew Street, Glasgow, which had become inadequate to handle the ever increasing demand in Scotland for the products, including the well-known Griffin-Grundy metal laboratory furniture, of the group. The branch manager is Mr. R. Carrington, and Mr. James Baxter, the field sales manager.

* * *

Film Cooling Towers (1925) Ltd., Richmond, Surrey, have recently been awarded the contract for three large natural draught water cooling towers, now under construction, for the Central Electricity Generating Board, at Richborough Power Station, Kent. This company has also been awarded the contract for concrete natural draught water cooling towers for the power station and for the blast furnace and gas cleaning plants of the new steel works in course of construction at Llanwern, Nr. Newport, Monmouthshire, for Richard Thomas and Baldwins Ltd. At the same works, they will be supplying two multi-cell induced draught water cooling towers for the oxygen plant, the latter being supplied via British Oxygen Engineering Ltd.

* * *

Northern Aluminium Co. Ltd., is now known as **Alcan Industries Ltd.** This new name involves no change of ownership, manufacturing activity or sales policy. Its purpose is simply to identify the company clearly as a member of the Aluminium Ltd. of Canada enterprise—"Alcan" for short. Aluminium Ltd., with headquarters in Canada, is the world's largest producer of aluminium for international trade, accounting for about one-fifth of the whole free world primary production. It comprises some 50 companies in more than 25 different countries, engaged in all phases of aluminium production and marketing, but the heart of the business is the use of Canada's hydro-electric power resources for the efficient smelting of the bauxite mined in the tropical countries. The company's gross fixed assets exceed $1,400,000,000 and the integrated operations they represent include the mining of bauxite and other ores on four continents ; the generation of hydro-electric power ; the smelting of aluminium in six countries ; and the fabrication in more than 20 countries of some of the ingot into forms useful to industry. Aluminium Ltd. has sales outlets in 144 countries. Northern Aluminium Co. Ltd., was incor-

porated more than 50 years ago and is Aluminium Limited's principal fabricating company converting Alcan ingot into sheet, plate, sections, forgings, castings and other forms. The "Noral" mark will be continued.

* * *

It has been announced by Mr. E. M. Heap, joint managing director of **York Shipley Ltd.**, North Circular Road, London, N.W.2, that work has commenced on the first stage of their new factory to be built on a 20-acre site at Basildon, Essex. York Shipley Ltd. are one of the leading manufacturers of industrial and commercial refrigeration machinery and continuous expansion of their business over the years has resulted in their being seriously embarrassed by lack of adequate manufacturing space in their London and Nottingham factories. It is planned, in the first phase of this expansion factory, to transfer the manufacture of the York range of small hermetic and belt-driven condensing units, automatic ice-maker production, and other sections concerned with the assembly of commercial refrigeration equipment. Consulting engineers and architects of the new factory are Ove Arup & Partners, of London, and the contractors for the building work are W. & C. French Ltd., of Buckhurst Hill, Essex. It is expected that the new premises will be ready for occupation in the spring of next year.

* * *

(A/B) K. J. Levin, of Malmo, Sweden, co-operated with their London distributors, Bland Refrigeration Co. Ltd., of Richmond, Surrey, and exhibited this month at the Second Frozen Food Exhibition. A few of an extremely wide range of low-temperature cabinets is again on view and it will be seen that the design and quality are still ahead of the general trend as it prevails in this country to-day. There are no fewer than 26 different models of low-temperature frozen food display cabinets and in addition there is another range of low-temperature bulk storage cabinets available in this country, all manufactured and supplied from Sweden. It is a feature of Levin Refrigeration that no timber whatsoever is employed in the construction of these cabinets. This means that there can be no warping, no deterioration and no twisting. To-day many users are realizing how difficult it is to maintain a low-temperature cabinet at its maximum efficiency when manual defrosting takes so much time and causes so much labour. On the Levin-Bland stand were seen some of the latest models incorporating automatic defrosting of the top evaporator and also fully automatic defrosting of those frozen food display counters which are fitted with forced air circulation. On July 1 last (AB) K. J. Levin, who export to most parts of the world, opened their branch office in London to deal with the ever-increasing volume of business and enquiries which had rapidly increased during the previous year. This is the first Levin branch office that has as yet been established, and all Levin distributors and their clients now have the added advantage of a prompt and efficient service in the United Kingdom.

U.K. branch office : (A/B) K. J. Levin, 20, Beauchamp Place, London, S.W.3. Telephone : Knightsbridge 5973. Telegraphic Address : Levincool London, S.W.3.

London distributors : Bland Refrigeration Co. Ltd., Red Lion Street, Richmond, Surrey. Telephone : Richmond 0184.

* * *

W. Canning & Co. Ltd. are now marketing ball chroffles made from Rigidex high density polyethylene. These rigid chroffles are spherical in shape, diameter approximately 1¾ in., and are supplied for use in plating and pickling tanks, where they float on the surface of the liquid and form an inert blanket. This blanket minimizes spray and splashing of dangerous or objectionable solutions, which reduces busbar and ducting corrosion and provides an additional safeguard for plating shop staff. The chroffles also reduce heat losses from the surface of the bath and can save as much as 12 per cent. of the heating normally required. The chroffles are blow-moulded for Cannings by Lacrinoid Products Ltd.

* * *

Mr. James B. Duncan, C.A., has been appointed an additional director of the Transport Development Group Ltd. Mr. Duncan, who is 33, entered the service of the group in 1953. He became group accountant in 1955 and was appointed a manager of the company in 1959 with particular responsibilities in the fields of administration and new acquisitions. Mr. Duncan is a native of Glasgow, and a member of the Institute of Chartered Accountants of Scotland.

The framework, floor and exterior and interior panelling of this insulated delivery van are made from BAKELITE polyester resin reinforced with glass fibre. The van, built by Mann, Egerton Co. Ltd., of Norwich, is considerably lighter than more conventional models and has a payload of 13 cwt.

Wall's ICE CREAM again choose

LIGHTFOOT

Refrigeration . . .

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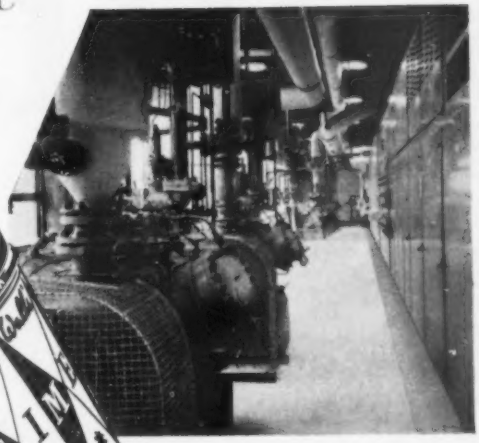

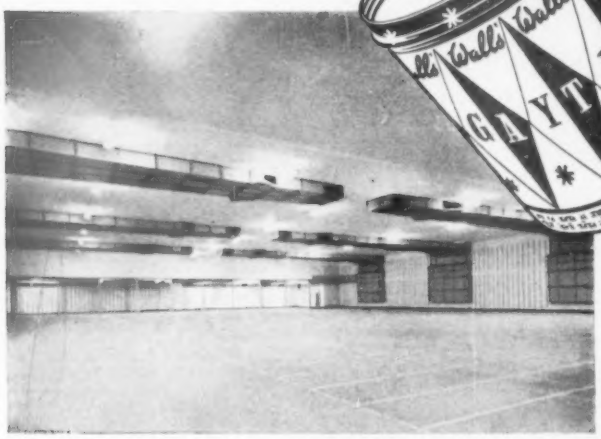

Photographs by courtesy of T. Wall & Son (Ice Cream) Ltd.

for their huge new factory at Gloucester which, when completed, will be the most advanced ice cream production unit in the world.

The first phase of this new project was completed when the 600,000 cu. ft. ice cream storage room, seen in our left hand illustration, was put into operation recently. This room is cooled by ducted air circulation and is served by 20 steel finned, Glycol Defrost Coolers and 6, semi-radial, Model A56 Compressors.

During sixty years of association, Lightfoot have supplied refrigeration equipment to this famous company for over 100 cold stores including the 300,000 cu. ft. room at Craigmillar, Edinburgh and the new Acton Cold Store of 430,000 cu. ft.

THE LIGHTFOOT REFRIGERATION CO. LTD. ABBEYDALE RD. WEMBLEY, MIDDX. *Tel: PERivale 3322*

LIGHTFOOT
REFRIGERATION

who had

pressing reasons for going to Wales?

(A B) K. J. Levin, of Malmo, Sweden, co-operated with their London distributors, Bland Refrigeration Co. Ltd., of Richmond, Surrey, and exhibited this month at the Second Frozen Food Exhibition. A

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Cabinets with Back Shelves

Referring in his article in the September number of MODERN REFRIGERATION to one of the cabinets made by Robert Wahl, the West German manufacturers, our retail correspondent explained that it combined good scope for display with improved serving facilities, *i.e.* a shelf at the back for wrapping the goods and so on. He added: "I do not know of any standard cabinet in this country which incorporates a serving device of this kind."

"Levin Refrigeration, which was first introduced into the United Kingdom in 1958, has high-temperature display and storage cabinets available which employ this particular type of serving shelf as standard an open-top self-service or assistant-service type of refrigerator, suitable for general provisions and prepacked goods, we also have six models of our Kyl-O-Matic Parad which is fan assisted and is fitted with a similar shelf.

"Levin Refrigeration, therefore, can provide no fewer than 25 different

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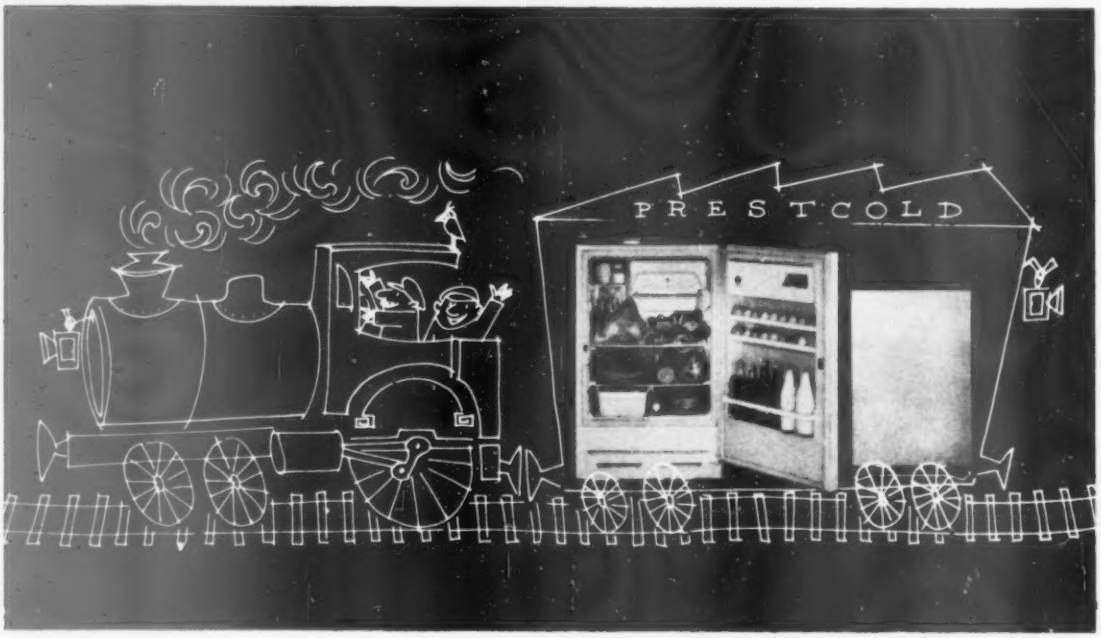


Who but Prestcold? After being 33 years at Cowley, Prestcold have moved to Swansea; here, at their big new factory—there are 50 acres of it—Prestcold have put in two and three quarter million pounds worth of the most efficient and up-to-date machinery to make it one of the biggest and most mechanised refrigerator plants in Europe.

What were the reasons? Prestcold wanted room for expansion and development. There is plenty of space here to make all Prestcold refrigerators and refrigeration equipment. The main assembly lines will be for domestic refrigerator models; but also from here will come all additions to existing commercial and domestic models, and the exciting new household equipment which Prestcold are planning to produce.

Why was it a good move? For Prestcold this is another move forward in expansion, upwards in prosperity. For you it is a profitable move too, because greater production and greater efficiency will help to keep the price of refrigeration down, encouraging bigger sales than ever.

PS

means Pressed Steel. And the Pressed Steel Company, parent to Prestcold, means business, expanding business—not only at Swansea, but at Cowley, Swindon, Paisley and Theale.

✻ **Prestcold's new address is: Prestcold, Division of Pressed Steel Co Ltd, Swansea, Glamorgan.**

Cabinets with Back Shelves

Referring in his article in the September number of MODERN REFRIGERATION to one of the cabinets made by Robert Wahl, the West German manufacturers, our retail correspondent explained that it combined good scope for display with improved serving facilities, *i.e.* a shelf at the back for wrapping the goods and so on. He added : " I do not know of any standard cabinet in this country which incorporates a serving device of this kind."

" M.R." has received a letter from Mr. William Nicol, M.B.E., B.SC., of Craig Nicol Ltd., Glasgow, drawing their attention to their Kintyre refrigerated cabinet, of which we are showing a rear view here. It will be noted that this model incorporates a shelf as well as a recess for wrappings at the back. It also has a glass case over and rising considerably higher than the refrigerated display level.

A frontal view of an 18-ft. 6-in. run of refrigerated counters of this type in the premises of George Guthrie & Sons Ltd., butchers, of Victoria Road, Glasgow, was, in fact, shown in MODERN REFRIGERATION this year. But, except under very close examination, the presence of the shelf at the back was not evident in the illustration.

We are grateful to Mr. Nicol for bringing our knowledge up to date.

* * *

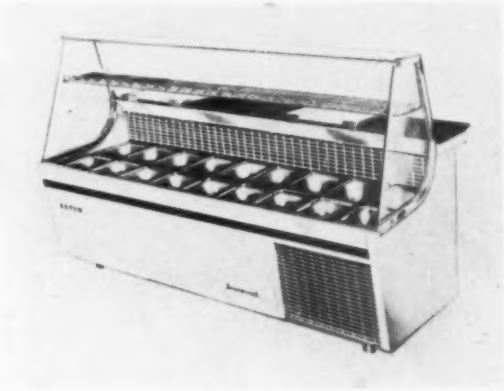
The manager of the U.K. branch office of A/B K. J. Levin writes :—

" On page 937 of the September issue of MODERN REFRIGERATION your special correspondent writes that he does not know of any standard refrigerator incorporating a serving shelf at the back, other than one particular product which he mentions.

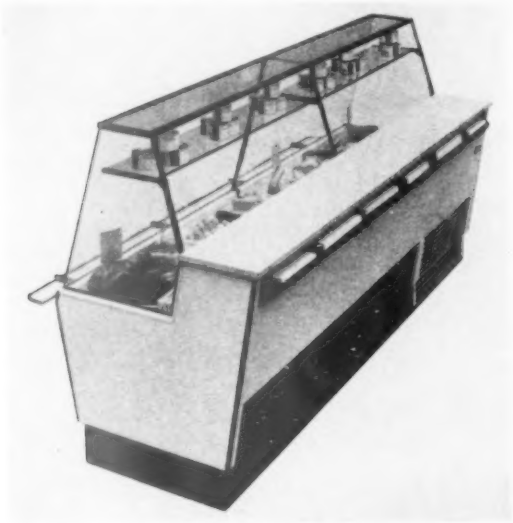
" Levin Refrigeration, which was first introduced into the United Kingdom in 1958, has high-temperature display and storage cabinets available which employ this particular type of serving shelf as standard and for your information, there are 13 different models of our Universal display counter so fitted. This refrigerator is particularly designed for general provisions, delicatessen, etc. There are also six different models of our Igloo display counter which is fan assisted and is particularly suited to the meat trade.

" For the user who wishes to buy an open-top self-service or assistant-service type of refrigerator, suitable for general provisions and pre-packed goods, we also have six models of our Kyl-O-Matic Parad which is fan assisted and is fitted with a similar shelf.

" Levin Refrigeration, therefore, can provide no fewer than 25 different cabinets out of a very wide range of refrigerators, all fitted exactly as described by your correspondent."



Levin cabinet with back shelf.



Nicol cabinet here described.

* * *

His many trade friends will be delighted to hear that **Mr. Jack T. Shevill,** of J. W. Shevill & Son Ltd., Newcastle upon Tyne, a keen sportsman, has had another good year at golf. He has won the following cups for his club (the fourth one for the second time) : Joseph Miller Challenge Cup (bogey) ; Larmour Challenge Cup (stroke) ; Dawe Challenge Cup (bogey) ; The Tavener Golfing Trophy (stroke) and, in addition, has won the " Golfer of the Year " trophy.

Left to right: The Rt. Hon. The Earl Waldegrave, T.D., Mr. Eugene Ruddin, C.B.E., Mr. J. R. Parratt and Mr. H. G. Jaeger.

Annual Luncheon

of the National Federation of Cold Storage and Ice Trades

IMPORTANT GATHERING AT CRITERION LONDON

Above: P. Clarke, F. Davidson and K. Lightfoot, O.B.E.

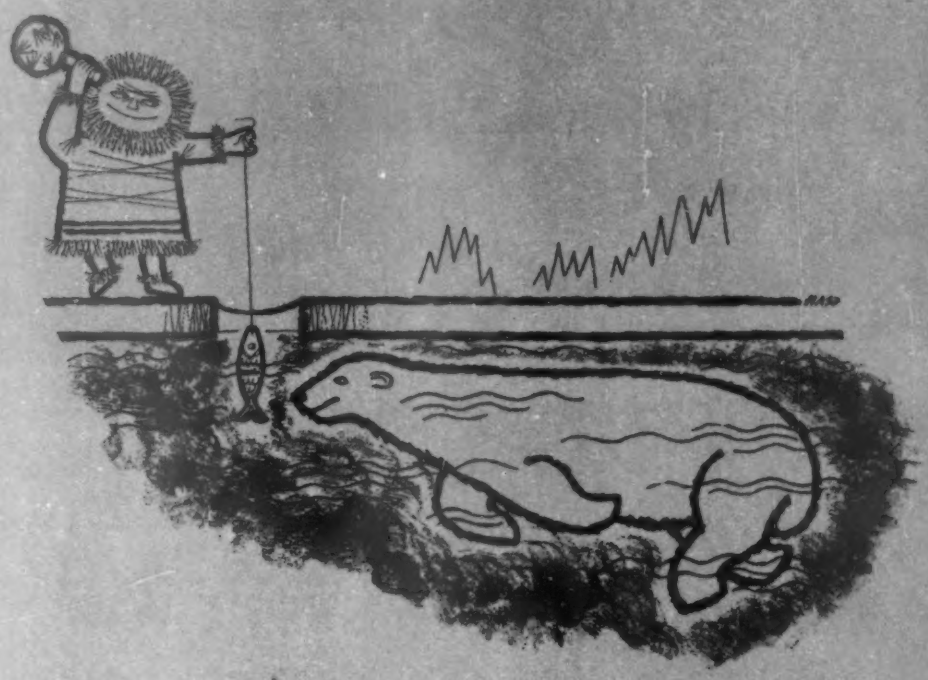
Above: From left to right: A. E. Kittle, R. S. Rowe, H. C. Sabey, R. F. Somerset and A. McQuaide.

Right: A. C. Davis and D. J. Brannan.

Below: From left to right: R. C. Picozzi, T. K. Hamilton and R. Finlay.

Below: From left to right: J. Burns, T. H. Johnston and E. M. Major-Lucas.

(continued on page 1069)



COLD LOGIC

When the problem is the lowering of temperature, it's a matter of cold logic to use 'Arcton' chlorofluorohydrocarbon refrigerants from I.C.I.—the first to introduce this type of refrigerant in Great Britain. (And the people with the greatest experience.)

Not that I.C.I. is resting on its laurels. Behind 'Arcton' refrigerants there's a background of constant research for further improvements. Wherever cooling is the problem 'Arcton' refrigerants can provide the answer. They're of consistent high quality and low moisture content; and they're non-toxic, non-corrosive and non-inflammable. What's more, there's an 'Arcton' refrigerant to suit *your* need.

'ARCTON' REFRIGERANTS

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

ICI

Left to right: The Rt. Hon. The Earl Waldegrave, T.D., Mr. Eugene Ruddin, C.B.E., Mr. J. R. Parratt and Mr. H. G. Jaeger.

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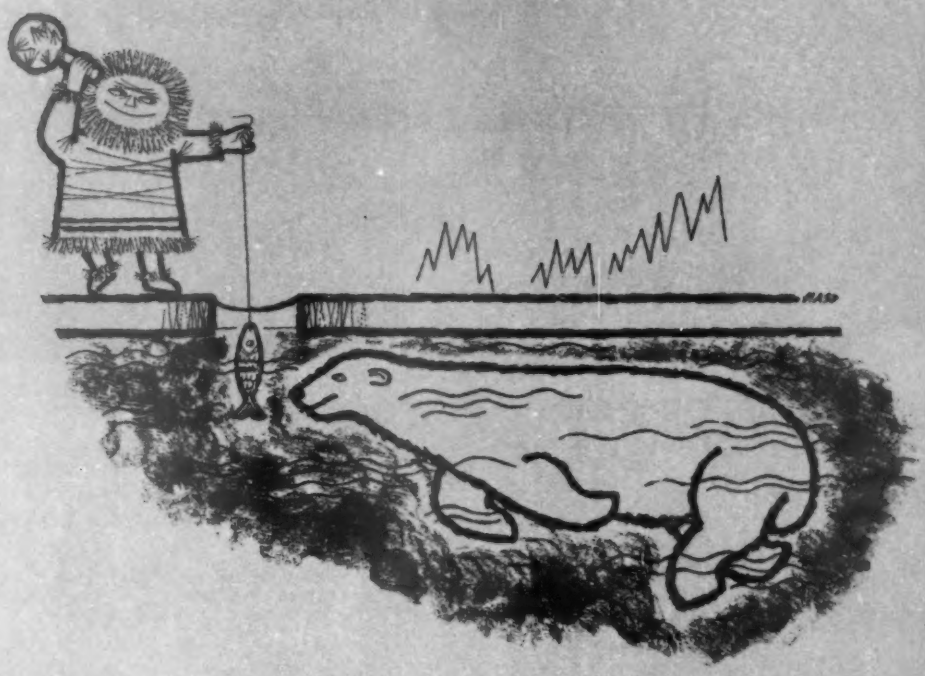

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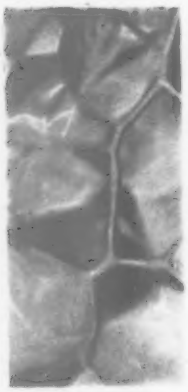

Styropor cells magnified x 100

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This is the secret of the outstanding insulating effect of expanded ®Styropor. One litre of this modern microporous foamed plastic contains as many as 8 million enclosed cells filled with air. Stationary air is a highly efficient insulating medium, and foamed Styropor contains approx. 98% of enclosed air. Insulating materials of Styropor are therefore extremely light, but they are also strong and rigid, withstand vibrations and shaking, and are resistant to moisture, acids and alkalis. In addition, they are unaffected by sea-water and there is no absorption by capillary action. The latter property is of particular importance in refrigeration, as it eliminates ice formation.

Expanded Styropor is used for the insulation of cold-storage rooms, hotel and household refrigerators, air-conditioning plant, refrigerator cars and trucks, and in many other refrigeration applications. Wherever efficient insulation is essential, there is no substitute for expanded Styropor.

BASF supply the raw material.

On request, we shall be happy to give you the names of firms processing Styropor in your country. Fill in the form below and send it to us.

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8 Million Air Cells in 1 Litre of Styropor

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BASF Advertising Dep. A52

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Badische Anilin & Soda-Fabrik AG

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N.F.C.S.I.T. LUNCHEON

M. Costa, M.B.E., B. C. Pike and T. Howard.

L. C. Conway, J. Greenwood and J. C. Middleton.

Right: J. W. Kuypers, L. A. Garrard, D. J. Mackness and C. Goldrei.

Below left: W. Lolley, E. J. Kane and B. Ryder.

Bottom left: From left to right: W. H. Frost, P. Tomling, C. Moore, V. J. Nunn, N. J. Barber and C. Spore.

Middle right: E. R. Lawrence and P. A. L. Wilson.

Bottom right: A. H. Garside and G. Dray.

ALUMINIUM in Insulated Trailer Construction

ONE of the wide variety of profiles in which aluminium sheet is today available has been put to good use in the construction of a new insulated trailer made by C. L. Whitaker & Co. Ltd., refrigeration and insulated vehicle builders of Grimsby.

The trailer is designed for conveying perishables preserved either by dry ice or by continuous temperature control. With either method the controlling air must circulate freely round the load and for this reason the load must not be placed flush against the sides of the vehicle. In the past this has been accom-

plished by fitting separate strips of beading at regular intervals on the interior surface of the vehicle. The lining of the trailer just completed has been constructed from Noral corrugated aluminium sheeting in "Miniature Mansard" profile, made by Northern Aluminium Co. Ltd. This sheet has a ridge at regular intervals and thus provides both a lining sheet and beading in one. This gives a considerable saving

Noral "Miniature Mansard" aluminium sheet.

in assembly time, provides a neat finish and eliminates crevices between the beading and the sheet, an advantage from the point of view of hygiene.

The floor of the vehicle is formed from ⅛ in. aluminium treadplate all joints of which have been welded by the argon arc method to prevent moisture and fish slime penetrating the insulating material under the floor.

The trailer is 26 ft. long, 7 ft. 8 in. wide and 7 ft. 6 in. high. The outer skin is of 18 SWG, Noral M57S aluminium alloy sheet. The insulating material is foamed polystyrene and is 5 in. thick in the sides and 6 ins. thick in the roof and floor. The chassis was supplied by the British Trailer Co., Kirkby, Liverpool.

Although not fitted on the vehicle illustrated, provision is made for fitting a Thermo King refrigeration unit on the front bulkhead. This system enables the correct temperature to be selected to suit the particular commodity being transported.

ELECTROLUX SERVICE BY APPOINTMENT

A SYSTEM for arranging visits by appointment for users of Electrolux products will be operating at all the company's divisional offices throughout Britain by the end of this year. Based on plotting methods used by the Services during wartime, the Electrolux appointments scheme is designed to make the most efficient use of each service representative and to advise each user when a call is to be made. The new Electrolux appointments system is based on movements worked out on a large wall-mounted plotting board founded on an idea by Mr. F. C. Reeve, Electrolux Ltd's service manager, who devised it in collaboration with Mr. A. Fieber, of the Electrolux display division. These plotting boards are already in operation in the London divisional office, 419, Oxford Street, W.1 and in some of the company's provincial divisional offices.

NEW PRESTCOLD SHOWROOM

A new showroom has been opened by Prestcold at 53, Upper Northgate Street, Chester. It will form a depot of the North Wales branch of the company's distribution system, which has its headquarters at Shrewsbury.

PATENTS

APPLICATIONS RECEIVED

July 6—Graham-Enock Manufacturing Co. Ltd., and Enock, A. G., P23644, Refrigerating plant. 11—Fink, E., Fink, C., Fink, R., Fink, P., and Fink, A., trading as Eisfink Carl, Fink, OHG, C24164, Table, etc., refrigerators. 20—General Motors Ltd., Williams, C. E., P25224, Refrigerator cabinets manufacture. 21—General Motors Corporation, C25430, Refrigerators, etc., door seal. 23—Pormor Ltd., Nicolson, F., P25717, Refrigerators, etc. 27—General Motors Corporation, C26106, Refrigerators; London Ice & Cold Storage Co. Ltd. and Warrington Tube Co. Ltd., Turner, H. J., P26172, Freezing, etc., apparatus.

August 3—Karner, F., C26817, Air-conditioned seat; Pelizzetti, I., C26935, Air-conditioning apparatus compressor cooling.

heat-X LIQUID CHILLERS

are now available up to

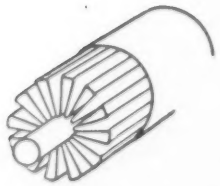
100

TONS CAPACITY

To be able to achieve a capacity of 100 tons within the extreme compactness of a Heat-X Chiller is a tribute to the efficiency of the patented inner-fin construction. This clever design is one of the unique features which make Dunham-Bush Shell and Tube Chillers the smallest big-performance chillers on the market.

Heat-X CH inner-fin liquid Chillers range from 2 to 100 tons capacity. With water, non-ferrous passages throughout mean no corrosion problems. Single pass construction prevents oil-trapping on the refrigerant side.

Details of construction, specification and dimensions are available. Please write for Bulletin HX/1001A.



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Portsmouth, Hants
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(4 lines)
Broadway/db 22

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★ Powered by the Tecumseh "pancake" compressor (15 million are in use all over the world).

★ Hermetically sealed to give years of silent vibrationless trouble-free service.

★ Fast freezing evaporators.

★ Tubon wire condenser for optimum performance.

★ Full five years replacement warranty.

★ All types of Hermetic Seal Refrigeration Systems designed and manufactured to your specifications, if desired.

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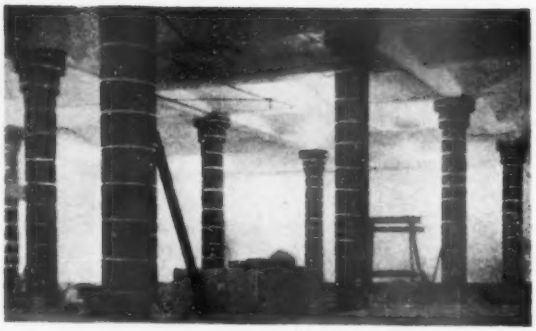


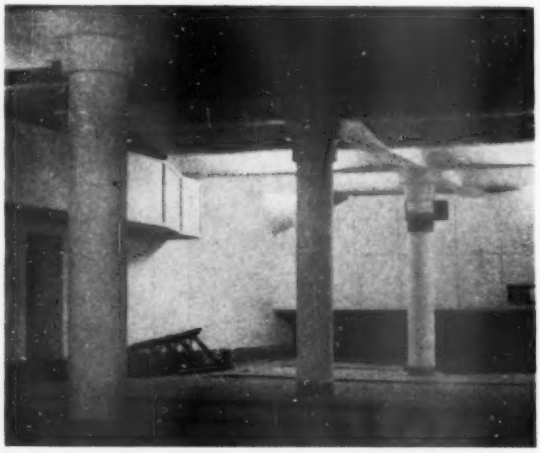
insulation

by

Part of a conditioning room at the Albion Brewery of Messrs. Mann, Crossman & Paulin, Ltd., London, E.1, showing progress of insulation work recently carried out by us.

KEENAN

Your enquiries for the insulation of Cold Rooms, Refrigeration Plant and Pipes, Water Mains, Storage Tanks, and for insulated doors and all cold store joinery will receive our careful attention.



MATTHEW KEENAN & COMPANY LIMITED
ARMAGH WORKS, TREDEGAR ROAD, BOW, LONDON. E.3.
Telephone: ADVance 3271

APPLICATIONS RECEIVED

August 10—York Shipley Ltd. C27707, Air-conditioning systems ; Neilsons (Ice-Cream & Frozen Foods) Ltd., Tate, H. R., P27742, Insulated vehicles, etc. 13—Ferguson, J. J., P28106, Refrigerators, frost-preventing device. 17—Fell, P., and Heaton, J. T., P28484, Refrigerators ; Licentia Patent-Verwaltungs-G.m.b.H., C28509, Refrigerating apparatus power supplying ; Lorentzen, J., C28470, Refrigeration plants etc. ; Westool Ltd., and Pollak, H., P28490, Refrigeration systems. 18—Atlas, S.A., C28663, Refrigerating cabinets ; General Motors Corporation, C28649, Refrigerator cabinets manufacture ; Radiation Ltd., and Buck, C. H., P28714, Refrigerators. 19.—Vickers-Armstrongs (South Manston) Ltd., Halliwell, J. A. and Ward, K., P28840, Foodstuffs freeze-drying plant ; Svenska Flaktfabriken A. B., C28792, Air-conditioning unit. 22—British Thermostat Co., Ltd. (Francaise des Thermostats, Soc.) P28964, Refrigerators switching devices. 26—Adir-Apparecchi Di Raffreddamento, S.r.l. C29499, Portable refrigerating unit ; Plus Sales Inc. Moser F. T., C29589, Frozen confection freezer variegator attachment. 27—Loh, W. C29678, Refrigerators. 30—Brassington, J. E., P29792, Air-conditioning apparatus.

COMPLETE SPECIFICATIONS ACCEPTED

July 20—A.E.I.-Hotpoint Ltd., formerly Hotpoint Electric Appliance Co. Ltd., and Taylor, H. T., 847,907 and 847,908, Heat pumps and refrigerators ; Electrolux Ltd., 848,420, Refrigerator cabinets ; General Utility Co. Ltd., 848,356, Ice cream freezing machines ; Bosch G.m.b.H., R., 848,195, Refrigerators. 27—Heat-X Inc., 849,158, Refrigeration ; Duct-less Hood Co. Inc., 849,304, Kitchen air-conditioners.

August 4—Chieregatti, L., 849,955, Air-conditioning apparatus of the induction type. 10—English Electric Co. Ltd., 850,772, Domestic refrigerators ; Morrison, W. L., 850,377, Chilling of foodstuffs and the like ; Electrolux Ltd., 850,802, Refrigerator cabinets ; A.E.I.-Hotpoint Ltd., formerly Hotpoint Electric Appliance Co. Ltd., 850,555, Cabinets for refrigerators ; United Aircraft Corporation, 850,358, Aircraft air-conditioning system. 17—Electrolux Ltd., 851,145, Absorption refrigerating apparatus.

August 24—De Havilland Propellers Ltd., 851,441, Air-conditioning and/or air pressurising apparatus for aircraft ; Electrolux Ltd., 851,488, Refrigerator chests and the like ; Bosch G.m.B.H., R. 851,667, Refrigerator doors. 31—McFarlan, A. I., 852,119, Air-conditioning system ; Chieregatti, L., 852, 603, Air-conditioning apparatus of the induction type ; Electrolux Ltd., 852,444, Absorption refrigerating apparatus. September 7.—Brown, Boveri & Cie, A.G., 852,898, Refrigerant compressors ; Havanto, V.K., 853,274, Refrigerators or cooling apparatus ; Samuel White & Co., Ltd., J., 852,999, Ice cream machines. 14—Union Carbide Corporation, formerly Union Carbide & Carbon Corporation, 853,584, Thermal insulation ; Union Carbide Corporation, 853, 585, Thermal insulation.

New Companies

The accompanying particulars of New Companies recently registered are taken from the Daily Register compiled by Messrs. Jordan and Sons Ltd.

Vulcan Refrigeration Ltd., 24a, Cookson Street, Blackpool. Secretary : Joan Bridge. To carry on business of manufacturers of and dealers in refrigerators and cold storage plant, etc. Nominal capital : £1,000. Directors : Kenneth W. Bridge, 8, Montpelier Avenue, Bispham, Blackpool ; Peter A. Taylor, 83, Greenwood Avenue, Blackpool.

Ajax Refrigeration (London) Ltd., 30, Cursitor Street, E.C.4. Secretary : P. Breddal. To carry on the business of manufacturers of and dealers in ice freezers, etc. Nominal capital : £2,250. Directors : Leonore Lewisohn, 6, Falkland House, Marloes Road, W.8 ; Gunnar K. Petersen, 82, The Avenue W.13 ; Poul Breddal, 2, Linden, Cedar Grove, Oatlands Drive, Weybridge.

Hull Refrigeration Ltd., 21, Northolme Circle, Hessle, E. Yorks. Secretary : Joyce D. Edmonds. Nominal capital : £500. Directors : James J. Edmonds and Mrs. Joyce D. Edmonds, 21 Northolme Circle, Hessle, E. Yorks.

Whittalls Refrigeration Specialists Ltd., All Saints Chambers, Eign Street, Hereford. Nominal capital : £1,000. Director : Thomas E. Whittall, 47, Church Street, Bishops Castle, Salop.

Deepfreeze (Sales) Ltd., 24a, Cookson Street, Blackpool, Lancs. Secretary : Joan Bridge. To carry on business of manufacturers of and dealers in refrigerators and cold storage plant, etc. Nominal capital £1,000. Directors : Kenneth W. Bridge, 8, Montpelier Avenue, Bispham, Blackpool ; Peter A. Taylor, 83, Greenwood Avenue, Blackpool.

Fairfields Cold Stores Ltd., Fairfields Wharf, Gale Street, E.3. Secretary : A. Lindsey. Nominal capital : £10,000. Directors : Arthur Reader, 29, Comyns Road, Dagenham ; Beatrice Bamforth, 3, Beaconsfield Close, Westcombe Park, S.E.10.

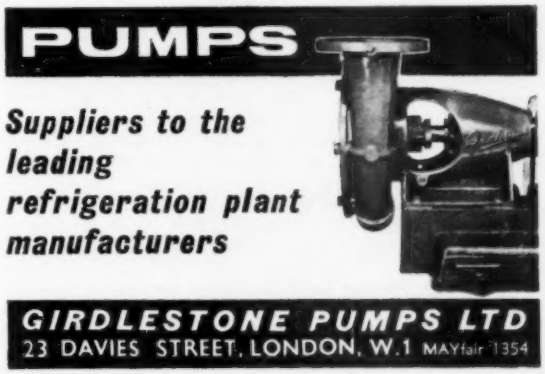
Harrisons Heating Ltd., 3, Elwick Road, Ashford, Kent. Secretary : D. C. Maycock. To carry on business of heating, ventilation, refrigerating and electrical engineers, etc. Nominal capital : £300. Directors : Stephen S. Harrison, 34, Old London Road, Hythe, Kent ; David C. Maycock, 26, The Hawthorns, Greenacres, Aylesford, Kent ; Brian H. Medd-Sygrove, 9, Allenfield, Ashford.

Air-Conditioning (London) Ltd., 56/64, Latchmere Road, Battersea, S.W.11. Secretary : Ivy Simmons. Nominal capital : £100. Directors : John H. Fisher, 20, Elizabeth Avenue, Enfield ; Harry Sayward, 55, Lyndhurst Drive, Leytonstone, E.11 ; Geo. C. Barwell, 6, Ennismore Gardens, S.W.7.

Williams Cold Storage Construction Co. Ltd. Nominal capital : £100. Directors : to be appointed by the subscribers. Subscribers : E. O. Davies, 107, Culver Grove, Stanmore, Middlesex ; J. Mills, 60 Dewsbury Road, N.W.10. Registered by solicitors : J. D. Langton & Passmore, 8, Bolton Street, W.1.

Refrigeration Centre (Blackburn) Ltd., St. Peter Street, Blackburn. Secretary : E. H. Atherton. Nominal capital : £4,000. Directors : Norman D. Briggs, 24, The Crescent, Cherry Tree, Blackburn ; Fred Briggs, 297, Bury Road, Tottington, Bury.

Cled Smith & Sons Ltd. To take over the business of dealers in refrigeration equipment, electrical and refrigeration engineers carried on at 233, Penarth Road, Cardiff, etc. Nominal capital : £2,000. Directors : Cledwyn Smith & Ira Smith. Subscribers : Geoffrey B. M. Williams, 36, Crystal Wood Road, Heath, Cardiff ; Anthony W. P. Gribble, 63a, Westbourne Road, Penarth.


PUMPS
Suppliers to the leading refrigeration plant manufacturers
GIRDLESTONE PUMPS LTD
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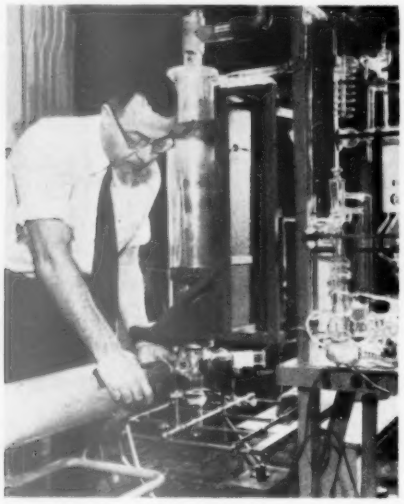
Composition, Nature and Effects of Free Radicals

Fundamental Investigation

To investigate the secrets of short-lived atomic and molecular fragments, the U.S. National Bureau of Standards has recently completed a three-year experimental and theoretical study, opening the way to several new areas of science such as low temperature chemistry, photo-chemistry of solids, the science of stabilized radicals, the study of thermal dissociation and many others.

THE U.S. National Bureau of Standards has recently completed a three-year experimental and theoretical study on free radicals, sponsored by the U.S. Department of Defence. Scientists from industry joined with the bureau's staff in this " Free Radicals Research Programme " to probe the secrets of short-lived atomic and molecular fragments. This centralized research activity not only revealed much about the production and nature of radicals but also paved the way for research in several new areas, including low temperature chemistry and the photo-chemistry of solids. Other important results of the programme are : A better understanding of low-temperature phenomena ; improvements in low-temperature techniques ; and advances in spectroscopic instrumentation and in X-ray and electron diffraction techniques.

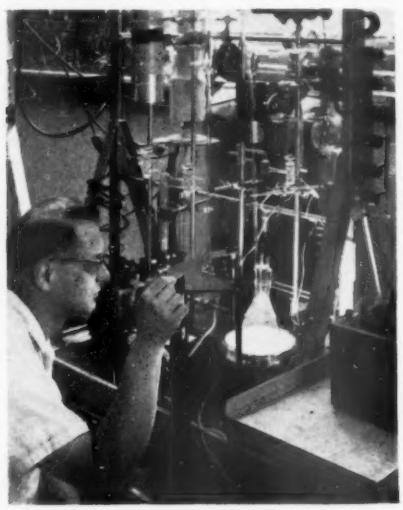


U.S. National Bureau of Standards free radicals researcher L. J. Schoen adjusts a spectroscope for studies of luminescence initiated in low-temperature condensates by photolysis or electron bombardment.

Although free radicals have been known to exist for over 50 years, only recently has research interest been focussed on their stabilization. Stabilized radicals can either be produced in a gas, which is then deposited as a condensed solid on a cold surface, or they can be produced, after deposition, in the condensed solid itself. In either case the excited species are frozen into immobility and sometimes display unusual phenomena such as bright glow, " flames," and flashes of light. When warmed up, they recombine actively, releasing stored energy.

Production of Free Radicals

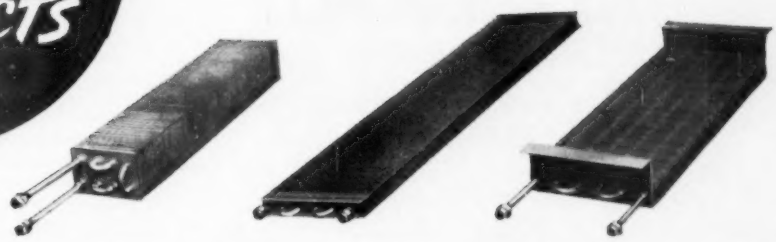
Of the several methods available for generating and trapping free radicals, the most extensively used at the bureau was an original high-temperature discharge, low-temperature collection technique, developed by H. P. Broida and J. R. Pellam. In this method, gasses are passed through a high-frequency microwave discharge at 2450 Mc/sec and then frozen at 4·2 K. The concentration of atoms and radicals produced in this way has been found to be relatively independent of the power applied to the resonator. In nitrogen, for example, magnetic susceptibility and electron spin resonance measurements indicate that the nitrogen atom concentration is about 0·1 per cent at 4 K. When the concentration of atoms



In studies of low temperature reactions at the bureau, M. D. Scheer produces free radicals by bombarding a solid with hydrogen atoms.

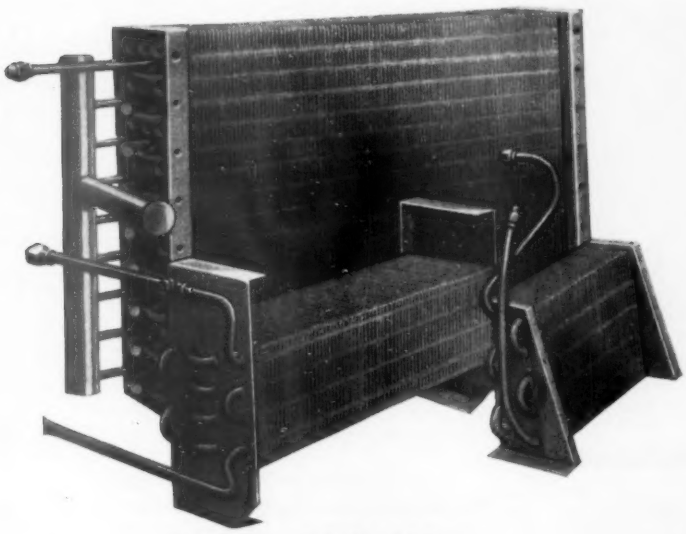
Use RA PRODUCTS

Manufacturers of Coolers and Condensers for Commercial, Industrial Refrigeration and Air-Conditioning Applications

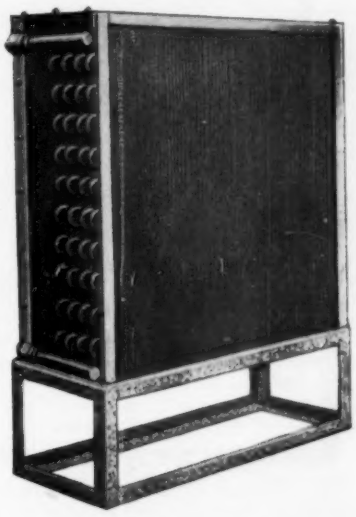


FINNED COOLERS

FOR :—DISPLAY CASE, COMMERCIAL and INDUSTRIAL APPLICATIONS



FINNED COOLERS
FOR AIR-CONDITIONING APPLICATIONS



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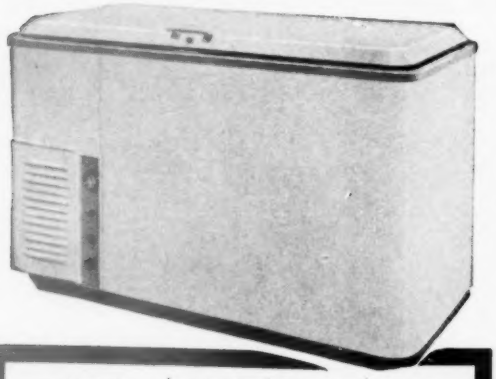

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exceeds this value of 1 part in 1,000, the solid becomes unstable and explosions are caused by the recombination of atoms.

In another attempt at generating radicals in a gas, thermal dissociation was employed. One system, which was designed by L. E. Kuentzel, has been used by J. T. Comeford, and J. H. Gould to study solids containing unstable molecular fragments. R. Klein, and M. D. Scheer employed another system in which hyrogen atoms, produced on a hot tungsten surface, diffuse into and react with cold solids to produce radicals.

Although it is possible to produce free radicals in a gas by photolysis (ultraviolet irradiation) or radiolysis (X-or -irradiation), these techniques were given no serious study. On the other hand, L. Wall, D. Brown, and R. E. Florin have hound -ray radiolysis of the solid condensed from the gas to be a highly successful method of radical production, and E. Hörl has employed electron bombardment extensively with results similar to those obtained in the gaseous discharge method. The concentrations obtained by exposing condensed solids to ionizing radiations rarely exceed 1 part in 1,000.

A fairly large amount of work on the mechanisms of radical production has been based on studies of free radical spectra. Even before the Free Radicals Research Programme was initiated, a semi-quantitative interpretation of some spectroscopic features of the very complex light emission from nitrogen deposits was given by C. M. Herzfeld and H. P. Broida. It was suggested that, in the deposition of nitrogen passed through an electric discharge, N atoms are deposited, radiate, and then recombine to form excited N_2 molecules which also radiate. Some atomic features (alpha lines) were attributed to a forbodden transition in N atoms ; other atomic features (beta lines) were ascribed to transition between levels in 0 atom ; and the molecular features (bands) were assigned to a transition of the newly-formed N_2 molecules.

It is now clear that the alpha lines do indeed arise from the transition proposed, although the situation is known to be vastly more complex than it was thought at first. The beta lines belong to transitions of 0 atoms and the bands to transitions of molecules. H. Goldberg and C. M. Herzfield applied a crystal field analysis to the transition postulated for the beta atomic features, and have found reasonable agreement between experiment and theory.

Recently V. Griffing has investigated the Alpha lines from a different point of view, assuming that an N atom replaces an N_2 molecule in the crystal lattice, and then moves to readjust the lattice to minimize its energy. Several non-equivalent motions of this type can be found, which give rise to enough levels to explain the line group in question. So far the results obtained are only qualitative, but the approach is a very promising one.

Radical Deposition and Trapping

The condensation of a gas upon a cold surface is one of the least understood of the processes that occur during stabilization of radicals initially produced in the gas phase. When a molecule strikes a surface, it may rebound back into the gas after a single collision with the surface, it may become bound to a surface molecule for a time before it escapes back into the gas, or it may migrate at random over the surface and coalesce in a process of nucleation with other such particles and thus become a permanent part of the deposit. Measurements of the condensation of argon on a 4°K. argon surface, by Bureau staff members F. A. Mauer and L. H. Bolz, and S. N. Foner of the Johns Hopkins Applied Physics Laboratory, indicated that 6 out of 10 atoms condensed while Scheer found that the condensation of iodine on a

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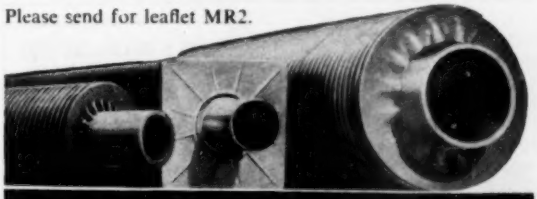

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77°K. glass surface occurred with nearly perfect efficiency. It is seen, therefore, that in addition to surface temperature, the material being deposited and the nature of the surface are of significance. In any case, a complete understanding of the stabilization of gaseous radicals in the solid state must be preceded by a more detailed insight into the deposition process. Although little experimental effort has been expended in this direction, a major part of the theoretical work has been devoted to explaining the mechanisms of radical deposition.

Several theories have been constructed to deal with the deposition problem. Two of these are statistical and study the number of ways in which radicals, molecules, and inert species can be laid down together. This approach, which employs various assumptions about the system, allows the upper limits of radical concentrations to be estimated.

One such theory was developed by J. L. Jackson and E. W. Montroll, who considered that radicals form chains. They studied three cases in detail : The deposition of radical chains, the deposition of linear chains containing radicals and molecules randomly distributed, and three-dimensional condensates obtained from a gas containing radicals only and from a gas containing radicals and molecules.

A second statistical theory was constructed by S. Golden, who postulated five three-dimensional condensation models : A densely packed model in which all sites in the solid are filled by a radical or a molecule ; a diffusely packed model in which all species condense one to a site and then recombine where possible ; a surface model in which each condensed layer comes to a stable state before the next layer is deposited ; a non-ideal model in which species may evaporate from a surface ; and a clustering model which assumes that clusters form in the gas and are deposited as such.

Although the statistical theories have the advantage of being logically straightforward, they ignore considerations of diffusion and are therefore likely to give high estimates of trapped radical concentrations.

An attempt to approach the problem by studying the detailed mechanisms involved in deposition was made by R. Zwanzig who calculated the probability of the adsorption of an atom on a solid. This theory, constructed for the simplest or radical chain model, can be used to predict mass effects and in certain cases relative deposition rates.

Important contributions on the structure of condensed gases at 4°, 20° and 77°K. (the temperatures produced by liquid helium, liquid hydrogen, and liquid nitrogen, respectively) have been made by the X-ray diffraction group. The possibility of obtaining information about the number and type of crystallographic sites available for free radical trapping is an attractive feature of this type of investigation. The materials that have been studied in some detail are argon, nitrogen, oxygen, water, ammonia, diborane, hydrazoic acid, and various alcohols. L. H. Bolz, M. E. Boyd, F. H. Mauer, and H. S. Peiser found that, in general, slow rates of gaseous deposition results in solids with a considerably less ordered structure than that obtained with rapid deposition rates. The use of an electric discharge in the gas prior to deposition increases order in solids, and heating amorphous solids causes an annealing to the stable crystalline configuration. Part of the released energy observed in the warm-up of excited solids must be attributed to these crystallographic changes.

Some interesting results were obtained by Hörl in an electron diffraction study of thin solid nitrogen films at 4°K. and 20°K. For extremely thin films at 4°K., the observed diffraction patterns indicate the presence of randomly oriented fine crystallites. As the amount of deposited material is increased, larger crystals are formed.

A number of significant facts about trapping forces have been discovered through spectroscopic studies. It has become fairly clear that the trapping of atoms in molecular lattices is a complicated phenomenon. For example, in the cases of N trapped in N_2 and 0 trapped in N_2, loose complex formation with molecules occurs. Both theoretical and experimental evidence leads to this conclusion.

Trapping forces have also been investigated by Jackson and B. Castle, who attempted to discover the existence

M. Peyron, guest worker in the bureau's free radicals research programme, generates free radicals by a bureau-developed electric discharge technique. As radicals become trapped on a cold surface (here a refrigerated glass tube), they give off a glow.

of positions in or on an N_2 lattice where an N_2 molecule could rotate, either freely or in a hindered manner. They calculated the energy levels of molecules on the surface of the crystal, and also studied the long-range interaction potential between N and N_2. Although experimental evidence for such behaviour exists in the spectral lines, the present results are so far inconclusive.

Characterization of Stabilized Radicals

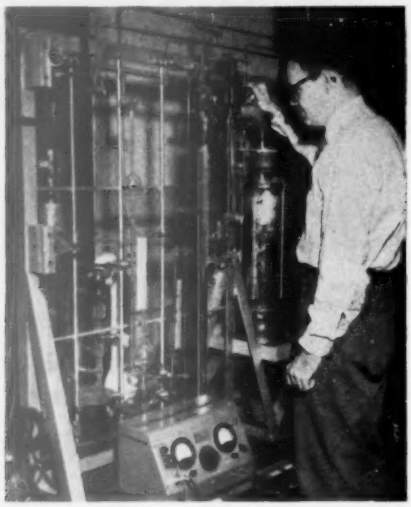
Once it has been established that radicals are present in a cold solid, the first question to arise is that of concentration stability. Wall, Brown, and Florin have performed several experiments which yielded information on this point. For example, electron spin resonance spectrometer measurements on nitrogen atoms generated in solid nitrogen by -irradiation showed no decrease in signal strength after the solid had been stored at 4°K. for 20 hr. On the other hand, a similar investigation on hydrogen showed a 50 per cent. decrease in concentration.

Trapped radicals disappear by at least two distinct mechanisms. One type of flash seems to propagate so rapidly that it appears to cover an area of several square millimetres instantaneously. A second type of flash—called a " cold frame "—propagates so slowly that the movement of a definite front can be discerned. Recent thermal and magnetic studies by B. J. Fontana indicate

that these flashes are intimately connected with some critical concentration of trapped radicals. This finding has led Jackson to work out a comprehensive treatment of stability in trapped radical systems and of the ways in which unstable systems disappear.

This work consists of three major parts : The first part uses qualitative arguments to obtain a simple expression for a critical concentration, n_c, of trapped radicals, which, if exceeded, gives unstable systems that decay explosively ; the second part consists of a detailed analysis of discrete sequences of radical reactions, with an analysis of the circumstances under which steady states can exist ; and the third part involves a study of the partial differential equations for the average values of concentrations. Remarkably, all three treatments give the same criterion for stability.

In addition to the techniques already mentioned—electron spin resonance and optical spectroscopy—the Bureau has employed mass spectrometry in studying free radicals. This method was used by J. T. Herron, J. L. Franklin, P. Bradt, and V. A. Dibeler to study gaseous recombination kinetics, and to investigate the reactions of atoms in the gas phase. They also made a mass spectrometric determination of the N-atom concentration in the afterglow region of nitrogen excited by the electric dis-



O. S. Lutes uses a calorimeter to measure the heat energy produced by the recombination of frozen free radicals.

charge method. This number, which is between 1 and 2 per cent. provides an upper limit to the concentration of atoms in the condensed nitrogen.

H. P. Broida, O. S. Lutes, G. J. Minkoff, F. Scherber, and J. Gallagher have used calorimetry to measure the energy liberated by various discharged gases condensed at 4°K. Although results indicate that as much as several per cent. of trapped energetic species are present in the solids produced in this fashion, this estimate is thought to be too high.

Other measurements on gases condensed at 4°K. included determinations of the index of refraction by J. Kruger ; the thermal conductivity by R. J. Corruccinim, H. Roder, J. T. Clarke, A. Chatenever, and R. Gorden ; and the dielectric constant by N. L. Brown. All results were consistent with the finding that radical concentrations generally are very low.

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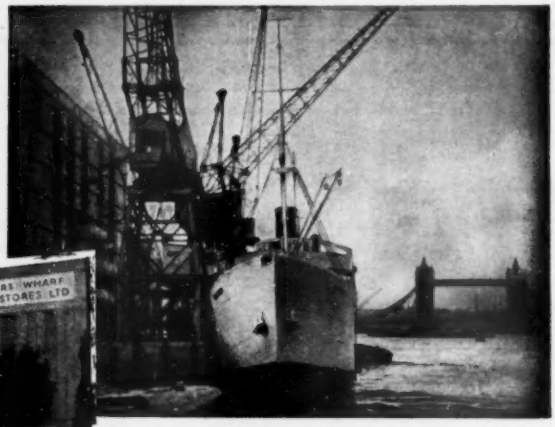

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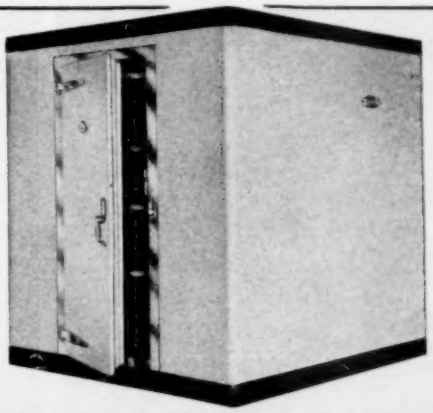

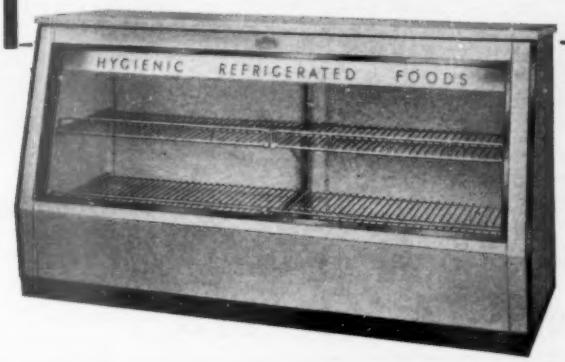

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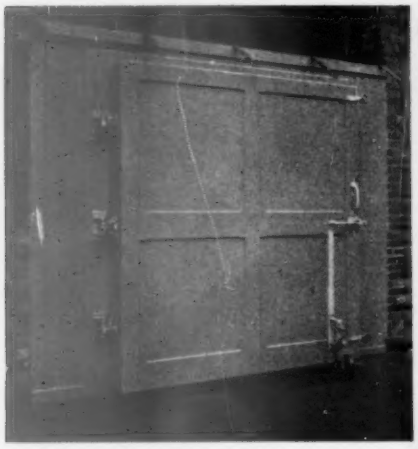

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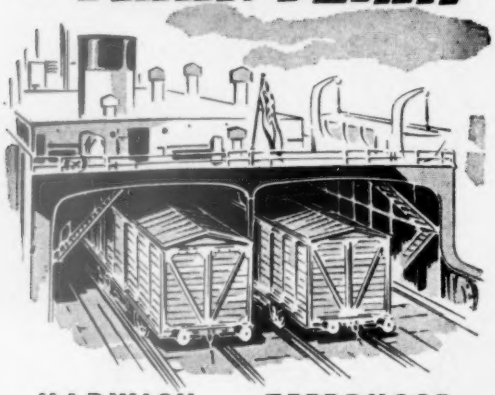

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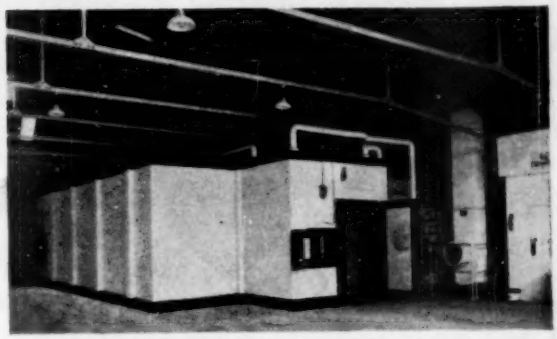

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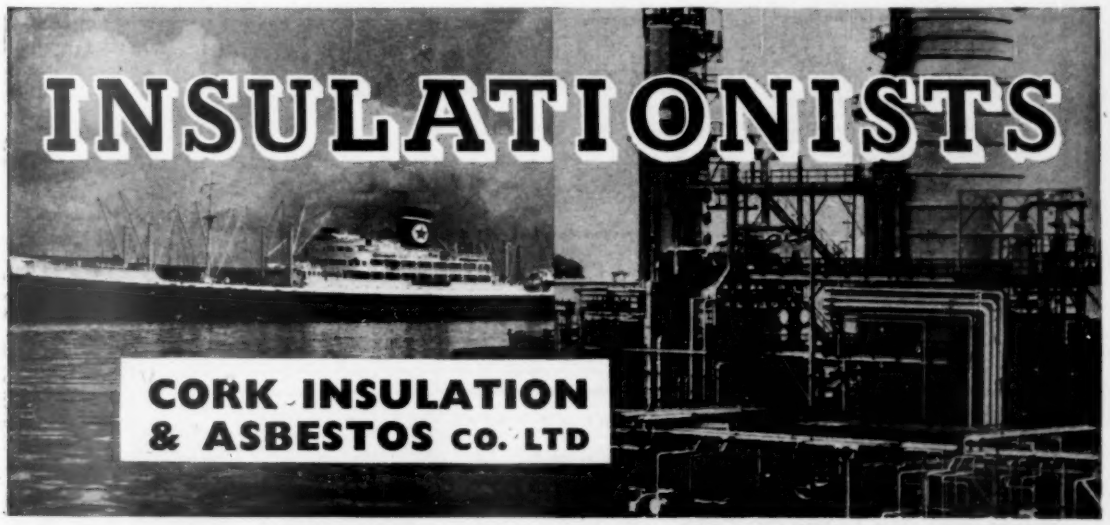

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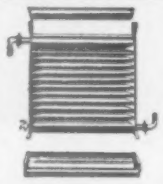

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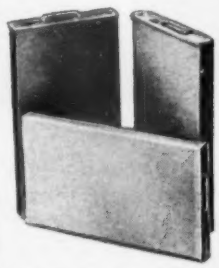

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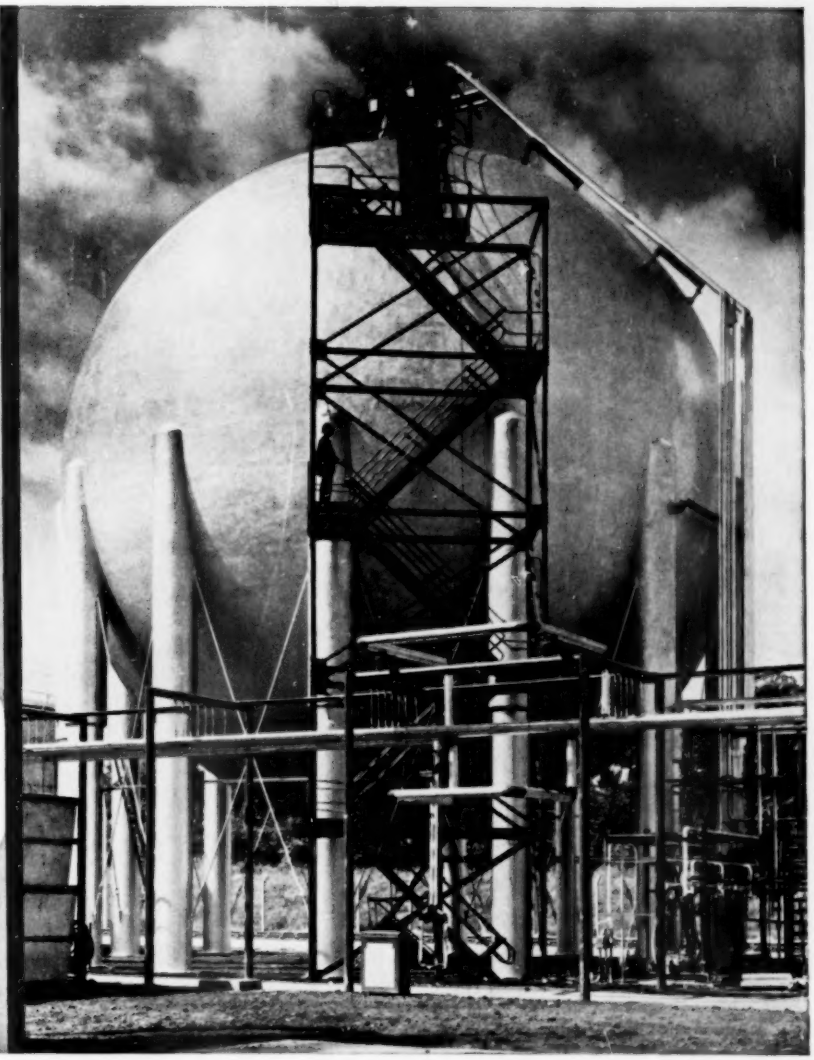

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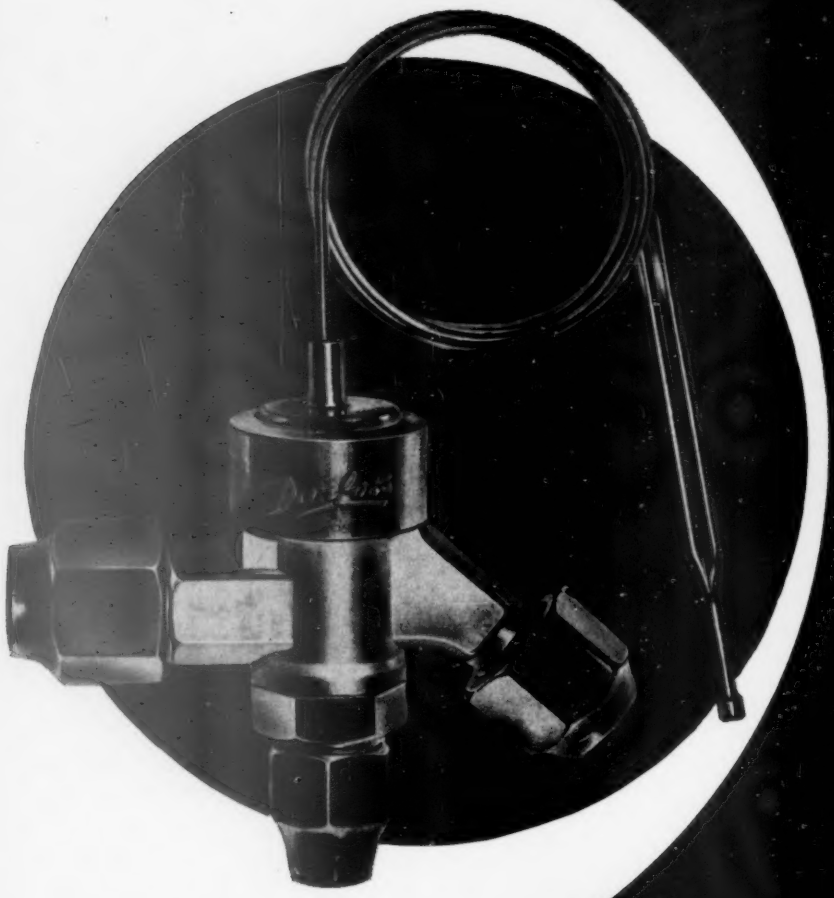

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